AMATEUR WORK

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A MODEL ELECTRIC RAILWAY.

ROBERT GIBSON GRISWOLD.

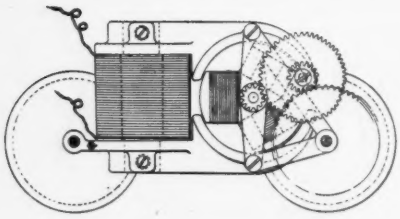
II. DETAILS AND ELECTRICAL EQUIPMENT OF MOTOR CAR.

The buffer-plate 9, which also forms an extension of the platform by virtue of a spring mounted on its pin, tends to keep the cars tightly coupled together, and prevents the couplers from becoming unhooked in rounding curves. It is made of a piece of hard brass (sheet) bent to the shape shown. The pin is made from a piece of brass wire riveted into a hole in the bearing surface and soldered thereto, or it may be made of a long, slim, flat-headed nail, the head being soldered to the plate. This nail or pin passes through the hole drilled in the platform, and should extend a short distance beyond the edge inside so as to admit of a small washer being soldered thereto to prevent its coming out, and to also form a stop against which the buffer spring 10 may act. This spring should be fairly stiff, and is what is known as an "open spring," or one that has its coils some distance apart when at rest, allowing room for compression.

The coupler 11, which has the draw-bar attached, is best made of cast brass as there will be two needed for each car. The pattern may be easily cut from cherry. File the casting to the proper shape and dimensions given, making the nose of the coupler smooth so that the two bars will hook easily when coupling. The holes are drilled for the attachment of spring 12, draw-bar lever link 15, and the supporting yoke 13. The spring 12 is made of small spring brass wire so that it will be very flexible and should be slightly open. One end hooks into the bar while the other surrounds the shank of a round-headed wood-screw. The yoke 13 is made of a strip of brass, and supports the inner end of the draw-bar as well as taking the pull thereon. The bar may be fastened to it by a small rivet or a brad passing through and into the car body. File the lever 14 out of No. 20 hard sheet brass and mount by passing through a slot cut in the edge of the platform. A small nail driven into the edge of the platform will form a pivot for the lever. Make the link 15 of such length that it will allow the bar to float from one end to the other of the slot in the end of the frame. In mounting the coupler, have it so placed that when the two adjoining cars are coupled together the buffers will be slightly compressed and exerting a pressure on the hooks of the couplers. To uncouple the cars it is simply necessary to pull on the levers 14 which will immediately unhook the couplers.

ELECTRICAL EQUIPMENT.

As this particular railway is to be a model of the third-rail type, the current is collected by means of a suspended shoe sliding upon a rail or other conductor, which carries the current, the return circuit being made through the other rails upon which the car runs. This third rail must be thoroughly insulated from the others, or else a short circuit will occur and the current return to the generating source without passing through car.



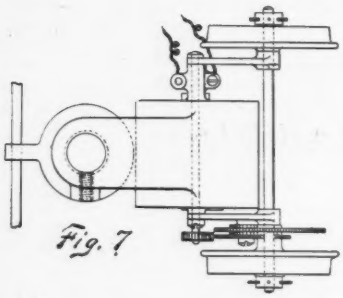


Fig. 7

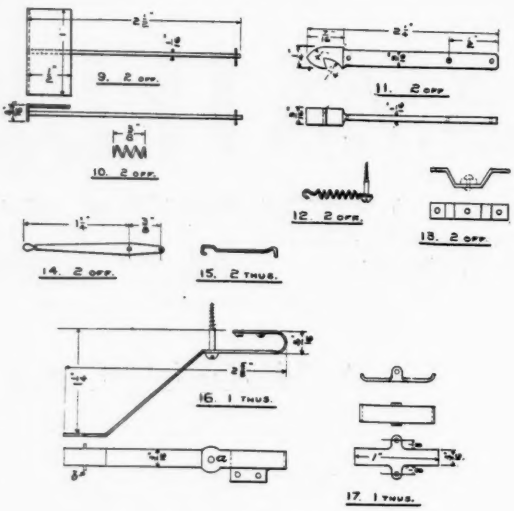


Fig. 8.

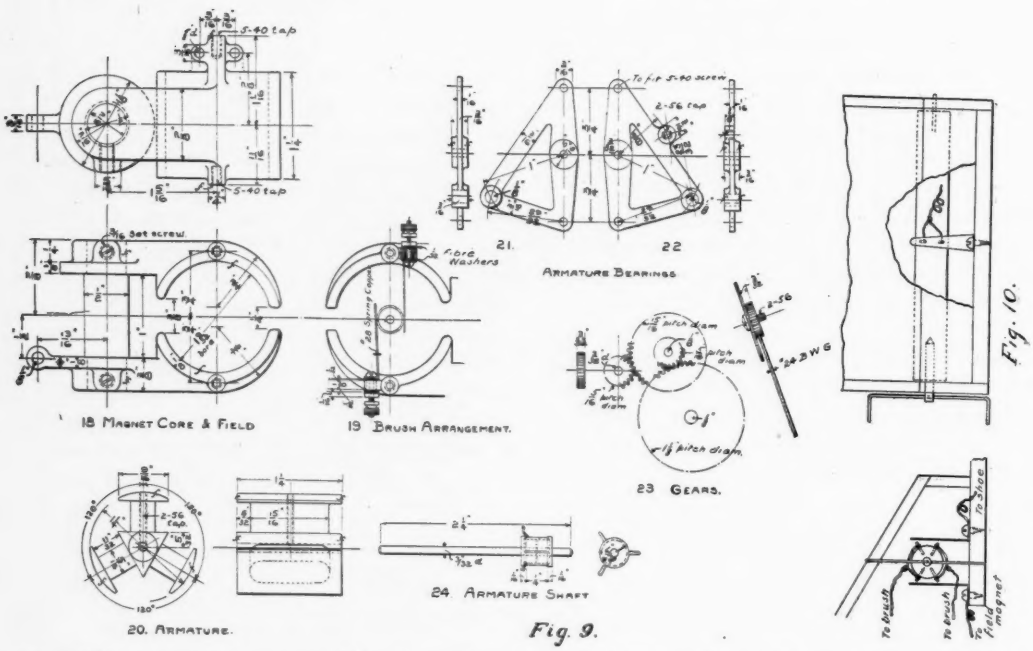


Fig. 9.

Fig. 10.

The sliding shoe 17 is supported by the spring 16 and caused to bear upon the third rail by its tension. The spring is made of No. 20 hard sheet brass bent as shown. The upper end has an extension to one side which allows it to be fastened to the car body by means of two small screws. At *a* a thin, round-headed screw passes through a hole, and then into the bottom of the car body. By turning this screw a proper adjustment of the pressure, with which the shoe is pressed upon the third rail, may be made. The head will prevent the shoe from dropping so low as to come in con-

tact with the other parts of the track in passing switches, crossovers, etc. The shoe proper is pivoted upon the two projections *b* of the supporting spring in such a manner that it will oscillate and make a good contact. It is prevented from turning too far by the extension of the spring on either side of the pivoting lugs.

The motor frame or fields, 18, Fig. 9, are cast from a good quality of soft cast iron, the only finishing required being in the armature bore and on the field magnet core seat. Make the pattern of cherry and finish carefully and smoothly. Make with shrink rule $\frac{1}{8}$" to the foot. Allow about $\frac{1}{16}$" in the bore to insure a good finish, and about the same amount on the ends of the bearing supports. The two sections are identical with the exception of the lugs just mentioned, one being longer than the other and on opposite sides. The lower section also has a projection cast to it for a support on the rear axle.

The core for the field magnet is best made of $\frac{1}{2}$" round Norway iron, which is soft and has a high magnetic permeability. Cut off a piece about three inches long and swing in lathe; then turn the ends which enter the fields down to $\frac{7}{16}$" finishing with a square shoulder. The section between the frames need not be turned, but a light cut will render it true and make the spool slip over it more easily. Make the ends fit very snugly into the holes drilled in the field ends.

Lay off the position of the core just turned on the field pieces and drill with a $\frac{7}{16}$" drill, or better, with a drill slightly under size and finish to size with a reamer. If these holes are drilled first, however, the core ends may be made to fit snugly by filing. Drill the holes for the set screws shown with a No. 26 drill, and tap with a $\frac{3}{16}$" machine screw top. Now put the three pieces together as shown in 18 and screw the set screws in hard so as to firmly bind the three in position. The set screws usually have a rough blunt point, which may cause the work to turn; it will be better to grind the ends flat before inserting.

Now clamp the frame on the carriage of a lathe, inserting a small piece of iron between the field ends opposite the magnet end, so that the clamp will draw them together. Adjust so that the center line of the armature bore coincides with the center line of the lathe. Then insert a boring bar, and with a light cut carefully bore the bore to 1 $\frac{9}{32}$" diameter, finishing with a very light cut. Then run the cutter out until it will touch the cast projections and face them off, thus insuring that they will be true with the bore. Now drill and tap the holes for the bearing screws, using a No. 38 drill and a 5-40 tap.

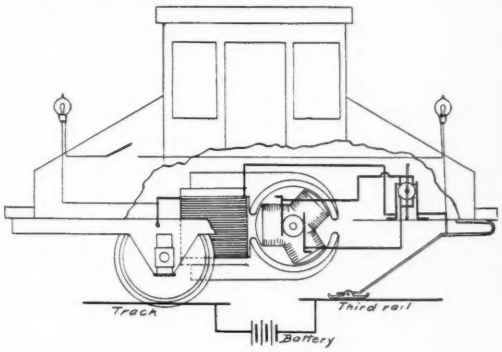


Fig 11

In view 19 is shown the method of making and supporting the brushes. Drill the lugs with a $\frac{1}{8}$" drill. From a piece of hard fibre cut two small plugs and drive into these holes. Then drill a $\frac{1}{16}$" hole through the center of these plugs. From the same fibre cut four small washers $\frac{1}{32}$" thick and $\frac{1}{4}$" in diameter with a $\frac{1}{16}$" hole in the center.

The brushes are made from No. 28 B. W. G. hard spring copper and bear against the commutator as shown, that the armature may turn in either direction without the segments of the commutator catching the end of the brush. Bend one end at right angles and drill a $\frac{1}{16}$" hole therein. The screws are brass, $\frac{1}{16}$" diameter and about $\frac{3}{4}$" long. Make two brass nuts $\frac{1}{4}$" in diameter, tapping each with a $\frac{1}{16}$" tap to fit screws. Then make two thumb nuts as shown and tap with a $\frac{1}{16}$" tap. It is a good plan to solder the head of the screw to the brush as better contact is thereby secured. To mount, run the screw through the hole in the rubber bushing, first threading on a fibre washer. Then put on another fibre washer and then the brass nut, setting it up hard. The thumb nut is then put on and set up when the wire is attached. The brushes should not be put on until the motor is finished.

The armature bearings 21 and 22 are cast from brass, the patterns being made of cherry. They

are $\frac{1}{16}$″ thick and the pads for bearings glued on. Allow enough on the sides of the pads to finish and lay off the holes accurately and drill. With the exception of the lug on one, which supports one gear, the patterns are alike and one may do for both, the lug being filed off of one when finished.

When these bearings are in place they should hold the armature exactly in the center of the bore, making the air gap equal all round.

The armature 20 is of the three-pole type and made of cast iron. In the pattern allow sufficient on each pole to give a good finish to size; face the ends and one side where it bears against the bearings. Drill and tap a hole in one pole for a set screw which binds the shaft in place.

The gears which transmit motion from the motor shaft to the wheels are shown in 23. They are made of thin sheet brass and similar to those used in clock works. The number of teeth is not particular so long as they mesh properly, as the pitch diameters will give the proper speed reduction. The pinion of the middle gear is permanently fastened to the gear itself, and both turn on a shoulder screw shown.

The large gear is soldered to the hub of the track wheel as shown in the top view in Fig. 7. The armature shaft pinion is driven onto the shaft and holds by friction, although if too loose, it may be fastened with a little solder. If it is fastened securely to the shaft, the shaft will have to be pulled entirely through the armature when removal is desired on account of the bearing. The armature shaft 24 is made of a piece of steel wire or drill rod and must be perfectly straight.

The commutator also shown in 24 is simply made. Turn from a piece of hard rubber, or fibre, rod, two pieces $\frac{5}{16}$″ long. At a point $\frac{1}{16}$″ from one end, turn them down until they fit very snugly into a $\frac{5}{16}$″ brass tube, cutting under as shown so that the beveled end of the commutator segments may be securely held by the overhang of the flanges. Now cut a piece from the $\frac{5}{16}$″ brass tube $\frac{5}{16}$″ long and bevel each end. Then cut this cylinder exactly in three segments (longitudinally) with a small fine saw, and solder a small strip of copper wire to each, at one end, which serve as a connection, for the armature windings. This tongue may be made a part of the segment by carefully working the piece out with a file.

No assemble the commutator, drive one piece of the fibre core onto the shaft to its permanent position. Then arrange the three segments so that there is a space between each and bind around with a piece of wire. Then place the other half core, on the shaft and force it home. The binding wire may now be removed and the segments will be securely held in place. The fibre cores must be very tight fits on the shaft.

The motor is now ready to be assembled as shown in Fig. 7. First wind the field magnet with No. 18 single silk covered magnet wire. Make two wooden flanges to slip over the ends of the core and put a small center in each end of this core that it may be swung between the lathe centers. Cut out four paper washers $1\frac{1}{8}$″ in diameter with a $\frac{1}{2}$″ hole, and put two on each end of the spool inside the wooden flanges. Now drive the flanges on and swing in the lathe, securing one flange to the face plate with a cord or nail to drive it. Then wrap one layer of paper around the iron core and coat with shellac. Let the end of the wire pass between the two paper washers at one end, and then through the hole in the middle and around the core. Now wrap the wire on slowly and carefully; making each layer as close and compact as possible. As each layer is wound on, coat it with shellac. When winding the last layer, double a piece of thin tape about $\frac{3}{8}$″ wide in two and lay under the last five or six turns, the doubled portion out. Then wind over this until the last turn, which pass through the loop, and draw up against the other turns by pulling the loose end towards the middle of the spool.

Coat well with shellac and put in a warm oven to dry for a day, baking it until the shellac is thoroughly dry throughout the coil. When it is so the wooden flanges may be knocked off and the wire will be found cemented into a solid mass, and a paper washer between the wire passing to the inside turn and the overlying turns. The field pieces may now be secured in place, and the gear side bearing put in place.

Now wind the armature with No. 25 single silk covered wire, winding each pole full, but making the winding pass around *each pole in the same direction*, and winding the same amount of wire

on each pole, that the armature may not be out of balance. Now connect the bored ends of the wires in the following manner; *connect the inside turn of the one coil to the outside turn of the next succeeding coil* and solder each junction or connection to *one* commutator segment, first placing the shaft in the armature and securing it by the set screw. Give a couple coats of shellac and bake in an oven until dry, being careful not to get any varnish on the commutator segments. Next put the armature in place and put on the other bearing. Drive the armature pinion into place and mount the middle gear.

Then put in the axles, and secure the driving gear to one wheel as shown in Fig. 7. Pass the other axle through the lug on the under side of the motor, and mount all in the truck frame as shown in the first chapter.

In Fig. 10 is shown the commutator for reversing the direction of rotation in the armature and consequently the direction of travel in the car. It is simply a cylinder of wood $\frac{3}{8}''$ in diameter, extending from side to side of the body and supported by two pins in the ends. One end has a double crank soldered thereto, the office of which will be spoken of in a later chapter. Drive in four brass brads as shown about 60° apart and solder a wire to them as indicated. Then mount two copper brushes which will just clear the brads when in the position shown, but which will touch them when the cylinder is turned 30° in either direction.

The wiring diagram is given in Fig. 11. The motor and light circuits are separate so that either may be operated independently of the other. Connect the sliding shoe with one commutator (reversing) brush. Connect the other brush to one terminal of the field magnet, the remaining terminal of magnet coil being soldered to the frame. Connect the brushes to the nails as shown. The current will now flow through the field magnet in the same direction at all times, but a movement of the reversing switch will cause the current to flow through the armature coils in opposite directions, thus reversing its rotation.

The head lights are connected in shunt across the motor circuits and should have a small switch connected in series, that they may be cut out.

The path of the current is then from the battery rough the third rail and shoe to the reversing switch brush; then through one of the brads to the armature, thence back to the other reversing switch brush, thence through the field magnet, frame. wheel and track to the battery.

The track, magnetic switches, semaphores, reversing connections, etc., will be treated in the next chapter.

A CHURCH BELL COUNTRY.

In Mexico the church bell holds a position akin to its exalted stand in Japan. In one town of 32,000 population there are 14 churches, which proportion holds in many other Mexican cities. Each church has from two to six bells each, of which the greater number are cracked and sadly out of tune. The Mexican people are musical as well as religious, as is shown by the fact that the itinerant foreign piano tuner is seldom turned away. Some of these bells are very old and ponderous. In a certain cathedral in the capital hangs a bell which weighs 27,000 pounds. Some time ago the bell was in great danger of falling through the rotting of its supporting beam or yoke. It has been in constant service for over 300 years. In other parts of the country are belfries strewn with fragments of ancient bells which have long since ceased to toll and in whose prime, no doubt, have clanged out their messages to many of the characters of Mexico's early history of strife.

A most peculiar condition has arisen in New Orleans, in which the city has been visited by hordes of ants which have become as threatening as the plagues of Egypt. The appearance of these pests is due to the drainage of the city. The woodwork of the houses is speedily attacked and destroyed, and they thus make their way into warehouses in which costly goods are stored and cause great damage. They seem to be immune to insecticides. Their presence at this time is said to be caused by the drying out of the soil in which they could not breed while saturated, and they are multiplying in such numbers that they simply defy suppression. In one case a man's house was literally destroyed by them as they tunneled the timbers in all directions, leaving nothing but a shell.. The only preventative that seem to have any effect is creosote, and work has been begun on creositing the lumber and woodwork of houses to prevent the further ravages of these insects.

WOOD TURNING FOR AMATEURS.

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XIII. EXERCISES IN ORNAMENTAL TURNING.

HALL TABLE.

Fig. 98 shows a small table for the hall, a card receiver being placed on the table. This table was designed by Mr. Fulkerson of the Lawrence Manual Training School, to whom I am indebted for its use. This table, which may be made from mahogany, birch, plain or quartered oak, maple or bird's eye maple, is made in eight pieces. The list which follows gives the sizes of the stock required, the letters referring to Fig. 98.

4 blocks for legs *A*, 10″ long, 1 $\frac{3}{16}$″ square.
2 „ „ lower collar *B*, 4 $\frac{1}{4}$″ square, 1 $\frac{5}{8}$″ thick.
1 block for standard *C*, 22 $\frac{1}{2}$″ long, 1 $\frac{3}{4}$″ square.
1 block for collar *D*, 4 $\frac{5}{8}$″ square, 1 $\frac{1}{8}$″ thick.
1 block for top *E*, 10 $\frac{3}{4}$″ square, 1″ thick.

Care must be taken in turning the legs to get them all alike. The legs should be tested by placing the four, side by side, to make sure that the heads and tapered parts come at exactly the same place on each one. It will be noticed that the leg tapers at *A*, Fig. 99, from $\frac{5}{8}$″ down to $\frac{1}{2}$″ at *B*. This tapered surface is broken up by the series of three beads, making it considerably harder to turn the taper straight. The end of the leg *C*, Fig. 99 must be exactly $\frac{3}{4}$″ in diameter. If the work is hurried too much the turner is very apt to make the end taper somewhat, and so making it impossible to fit the leg tightly into a $\frac{3}{4}$″ hole.

The upper collar, shown at *D*, Fig. 98, is turned on the screw centre. The collar, when finished, should be chucked and the 1″ hole, through which the end of the standard passes, cut out with the $\frac{3}{8}$″ skew chisel. The lower collar, Fig. 100, had better be made from two pieces glued and doweled together, as it is very hard to get a block 3″ thick perfectly free from checks. The two blocks must each have one surface jointed carefully to insure a perfect joint. The two blocks are to be glued and fastened together with three $\frac{3}{8}$″ dowels. The holes for the dowels must not be bored too deep in the upper block, as the dowels would show when the collar was finished. To mark the centres for holes, mark a circle 2 $\frac{1}{8}$″ diameter on the exposed surface of the lower block; on this circle mark three points 120° apart. These points will be the centres required.

The dowels should be glued, as well as the two surfaces forming the joint, and the two blocks should be clamped tightly in a vise until the glue has become perfectly hard. The block should then be put on the screw centre, so that the surface *A*, Fig. 100, showing the dowels, can be turned first. The groove *D*, Fig. 100 should be made to come at the joint, and all dimensions taken from this joint.

When this end has been finished, the block must be turned round in order that the other end *B*, Fig. 100, can be turned. Before removing the block from the screw centre, mark the centre of the surface *A*, and drill a small hole in which to start the screw centre. When the block is turned round, and started on the screw centre, use this drill hole. If the block does not run out it may now be finished up, and the hole *C*, Fig. 100, for the bottom end of the standard, cut in. It often happens, however, that when the collar is turned round and placed on the centre, it will run out; if this happens, finish the collar in a chuck. The table top *E*, Fig. 98, is turned on the face plate. The shape of the edge can easily be varied to please the turner. Care must be taken in sandpapering this top to get rid of all the little concentric rings. Special directions for this work have been given in a previous chapter.

The standard *C*, Fig. 98, requires careful turning with very sharp tools, as the stick is so long that it is quite liable to vibrate somewhat. If desired, a series of five beads at the middle, and three beads at each end, may be used instead of the arrangement shown in the sketch. The middle part of the standard should be turned first, the ends being finished last.

When long and slender pieces, such as stand

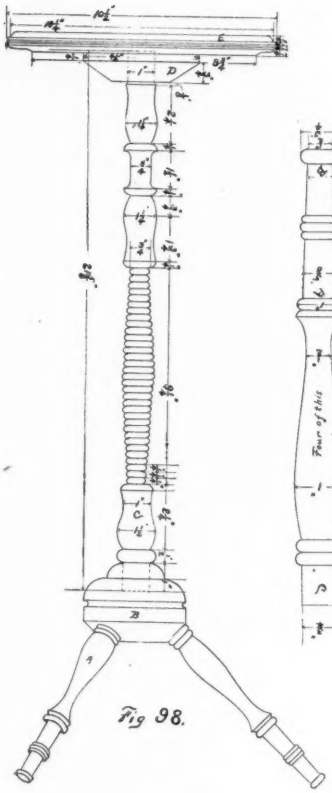

Fig 98.

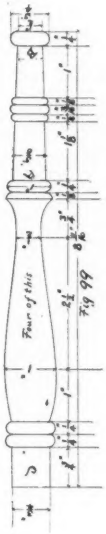

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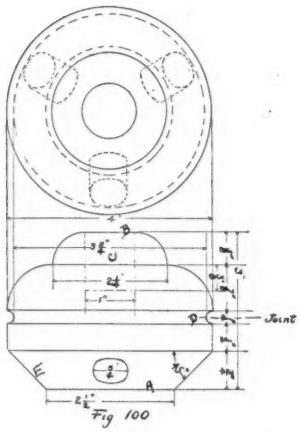
Fig 99



Joint

Fig 100

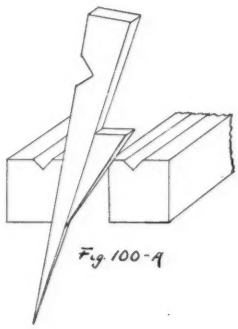
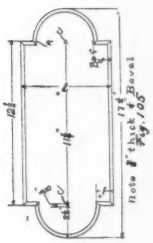


Fig 100-A

Fig 104 2 of this



Note 8" thick 1/4" Bevel Fig 105

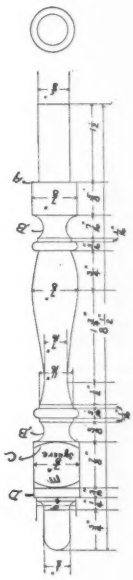
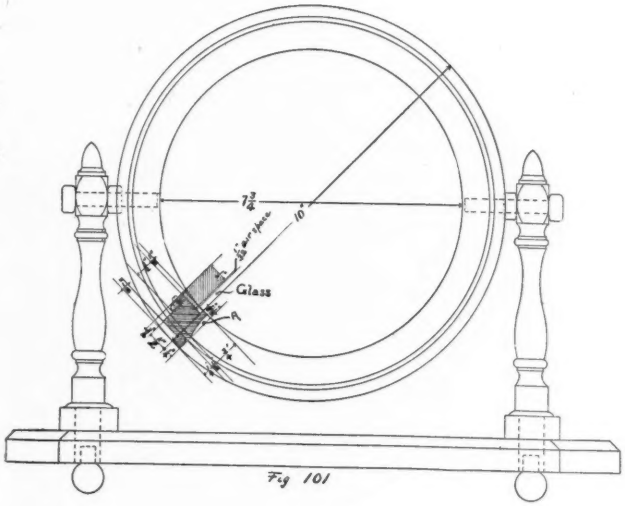


Fig 106 2 of this

Fig 102 2 of this



Glass

Fig 101

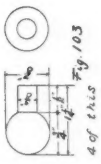


Fig 103 4 of this

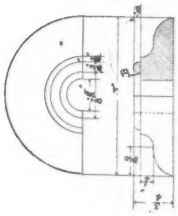


Fig 107 2 of this

ards, balusters, etc., are to be turned, a back rest or back stay is required to steady the work somewhere near the middle. A very simple back rest shown in Fig. 100, A, can be made by the turner from a small block. The notch near the top engages the work. The bottom is shown in the middle of the lathe bed, where a wooden wedge secures it sufficiently firm for ordinary requirements. This back rest is shifted above the bed at any part, as may be necessary, and fixed instantly by the wedge, which is only pressed tight by the fingers. The notch in which the work is steadied is often semi-circular in form, though shown V shaped in the sketch. For general purposes a V is best, but when a back is used exclusively for one size of work, it is better to cut the notch to fit as nearly as possible. The notch is, of course, all that supports the back rest from falling through the bed.

The speed of the work and the friction of the back rest will often generate heat enough to even char the wood. Soap applied as a lubricant, is the best material to lesson friction, many of the wood bearings of machines being successfully treated with soap as a lubricant. Before the back rest can be used, a small portion of the standard must be turned reasonably true. This may be done by using the left hand to steady the block, with the fingers encircling the work. A cylindrical surface having been turned, the back rest is brought up to it, the notch placed over it, and the apparatus fixed with the wedge. Thus an additional support is afforded, and the work is operated on very readily. The back rest may be moved to any part of the work, as is required, all that is necessary is to turn a surface for its bearings. These parts are afterwards turned true with the other surfaces, and all traces of them obliterated.

It will be noticed by referring to Fig. 98, that the end of the standard penetrates the bottom surface of the table top, a hole 1″ diameter and about $\frac{1}{4}$″ deep being bored for this purpose. The various pieces should all be filled before the table is put together. Four holes $\frac{3}{4}$″ diameter and $\frac{3}{4}$″ deep, are to be bored in the surface *E*, Fig. 100, of the lower collar. For these holes, which must be bored at right angles to the surface *E*, and so at an angle of 45° with the bottom surface *A*, use a block for a guide, with one end cut off at a 45° angle, using it the same as in the case of the plant stool described in the last chapter. The centres for these holes must be carefully marked out, and must come exactly 90° apart. The table should first be assembled without gluing, and the table tested with a level so as to be sure that the holes have been bored straight.

The legs and the standard are then to be glued, and driven into the holes bored in the lower collar. The upper collar is glued, and fastened to the table top with six 1 $\frac{1}{2}$″ No. 15 steel wire brads. The table top is next glued and forced on to the standard. As soon as the table has been assembled, a level should be placed across the table top to make certain that the standard is upright, and the table top exactly horizontal. If not, the various parts should be made to take their necessary positions, so that, when the glue has thoroughly hardened, the table will stand perfectly true. To make the table stand more firmly, a portion of the inside edge of each bottom bead on the leg may be cut off, thus giving a little larger bearing surface between the legs and the floor.

SHAVING MIRROR.

For the final exercise in this series of articles, I have chosen the shaving mirror shown in Fig. 101. This is the design of Mr. Wesson, Supervisor of Manual Training, Worcester, Mass., to whom I am indebted for its use. This exercise may be made of maple, plain or quartered oak, or brown ash, and is in 15 pieces. The list which follows gives the sizes of the stock required.

1 Base 18″ long, 7″ wide, $\frac{7}{8}$″ thick, planed both sides
1 block for legs 8″ long, 1″ square
block for pine 6″ long, $\frac{7}{8}$″ square
1 block for collars 2″ long, $\frac{3}{4}$″ square
2 blocks for rosettes 3 $\frac{3}{16}$″ square $\frac{7}{8}$″ thick, planed one side
2 blocks for standards 9 $\frac{3}{4}$″ long, 1 $\frac{1}{16}$″ square
1 board for frame, 10 $\frac{3}{16}$″ square, $\frac{15}{16}$″ thick, planed one side
1 pine board for back, 9 $\frac{1}{2}$″ square, $\frac{5}{8}$″ thick, planed one side

The base shown in Fig. 105, must be carefully finished, and all file and saw marks removed with sandpaper. The $\frac{1}{4}$″ bevel must not be marked with a gauge, unless an extremely *light*

line is made, as the guage lines would show after the bevel had been finished. In finishing the bevel at the corner *A*, Fig. 105. a file with a safety edge should be used. Care must be taken in finishing the bevel to keep it absolutely straight, and not cut below the lines. The top surface must have all plane marks and scratches removed, and will require considerable sandpapering. Use No. 1 ½″ sandpaper followed by No. ½″ and finally finish with No. 0 sandpaper. Four holes, ⅜″ in diameter, and ½″ deep, one of which is shown at *B*, Fig. 105, are to be bored in the bottom surface to receive the legs.

Two legs at *C*, ⅝″ diameter, with 11 ¼″ between centres, are bored to receive the standards. The two pins, Fig. 102, are to be turned from one block; the heads being butted together with $\frac{3}{16}$″ space between, to allow for cutting apart. The ends of the pin heads should be finished in a chuck.

The four legs, Fig. 103, are to be turned from one block, cut apart, and finished in a chuck. Owing to vibration it may be advisable to turn only two legs on one block.

To turn the collar, Fig. 104, fasten a block 2″ long, and ¾″ square to the screw centre, first boring a hole in the end of the block with a gimlet bit to prevent the block from splitting when it is forced on the screw. Turn the block down to ⅝″ diameter, and with a $\frac{5}{16}$″ drill held in a chuck fastened to the tail spindle, bore out a hole, taking care not to "feed in" the drill too fast. The collar is to be but $\frac{3}{32}$″ thick and will break easily. To prevent breaking it will be advisable to enlarge this hole a trifle with the ¼″ skew chisel, that the collar may slip easily over the shaft of the pin. Next turn the block down to ½″ diameter, and cut off the two collars with the acute point of the ¼″ skew chisel, first rounding the edges slightly as shown in the sketch.

The rosettes, Fig. 107, are turned on the screw centre. From the sketch it will be seen that a hole ⅝″ diameter is to be bored through the rosette to receive the end of the standard, so a V shaped cut should be made with the skew chisel to start the drill. The shoulder at *A*, Fig. 106, sets within the head at *B*, Fig. 107; the dimensions given must be followed exactly. If a ⅝″ drill and a steel chuck are obtainable, place the chuck with the drill in the head spindle, and the rosette against the tail spindle, the tail centre being removed for this purpose; and holding the rosette firmly with the hands to prevent turning and so catching the drill, with the aid of an assistant, drill out the hole, running the lathe at the slowest speed. If a drill and steel chuck are lacking, chuck the rosette and cut out the hole with the ¼″ skew chisel.

The frame shown in Fig. 101, is turned in exactly the same manner as the mirror frame shown in Fig. 72, of the June number of AMATEUR WORK. The curve shown at *A*, Fig. 101, is to be turned with the ¼″ round nose chisel. Care should be taken in boring the holes to receive the pins, not to split the frame. The pin back is fastened to the face plate with ⅜″ screws. For the mirror use German plate glass ⅛″ thick. The sketch calls for a mirror 8″ in diameter, but it will be better to cut the rabbet 8 $\frac{3}{16}$″ diameter, and use a mirror 8 ⅛″ diameter, so that no irregular cutting of the edge of the mirror would show from the front of the frame. The back should fit, so that a $\frac{1}{32}$″ air space will be left between the mirror and back piece, thus preventing the quicksilver from flaking off. A few pieces of pasteboard placed between the two surfaces will be sufficient to hold the mirror in place.

A few directions are given for the turning of the standards, Fig. 105. The hollows at *B*, Fig. 106, must be carefully turned. It is a fixed rule that, in order to cut the wood with the grain, every projecting member must be cut away from its *centre* right and left, and every hollow or reversed member cut from its *sides* and finishing in its centre. Practising on work of this kind will do much to train the eye. Remember, in turning the hollow, that at the beginning of the cut the gouge is turned on its side, and is gradually turned until on reaching the bottom, it has its hollow side up. To turn out a hollow like this with the gouge always on its back, would be to tear out the wood, making a very rough job and leaving ragged edges at the top.

The part *E*, Fig. 106, is left ⅞″ square with the corners rounded off, as shown by the curve *C*. The stock, to begin with, is 1 $\frac{1}{16}$″ square, so that this member will have to be planed down square with a block plane after the remainder of the

standard, including the member *D*, has been turned. *D*, is a collar $\frac{3}{16}$″ wide, and $\frac{7}{8}$″ diameter, so *E* must finally be planed down until the four sides are all tangent with the surface *D*, and at right angles to each other. The curve *C*, is cut with the $\frac{3}{8}$″ skew chisel. This had best be practised first on a piece of waste stock, as one is quite apt to catch the tool at the first trial. In assembling the various parts they should first be put together without glue, to make sure that the holes in the rosettes and base are exactly straight.

The legs are glued and driven into the base, which is then tested on a level surface to make sure that it does not "rock", any high spot can be removed with file or chisel. The rosettes are glued to the base, the grain of the rosettes preferably running with the grain of the base. The standards are glued through the rosettes and base. The back is fastened to the mirror frame by four $\frac{3}{8}$″ No. 3 wood screws.

In this series of articles I have said nothing of the extra appliances or attachments that can be used on a lathe for eccentric and elliptical turning, spherical and puzzle turning. Many ornaments and mouldings of various kinds may be obtained by a skilful adaption of plain turning.

Fancy turning in ivory, inlaying and stamp inlaying, mosaic design work, chasing, spiral and twisted turning; all these what the appetite of the amateur turner for a systematic study of higher turning. I have now in preparation a series of articles on this Advanced Wood Turning, and these articles may later appear in AMATEUR WORK should there be a demand for them among readers, who are invited to communicate their wishes in this matter to the editor.

According to the records of the Government Weather Bureau, the "Cave of the Winds" has been discovered at last in Point Reyes, California, which is accorded to be the windiest spot on earth, or at least in this part of the world. For three days it blew at the rate of 102 miles per hour and for a short period at 120 miles per hour; this last effort disabled the anemometer by ripping all the cups from the arms. It is reported that the weather tower is a fortress, and pedestrians who have business in that vicinity have to keep under the lee of the cliffs to avoid being blown off the earth.

A FOLDING SCREEN.

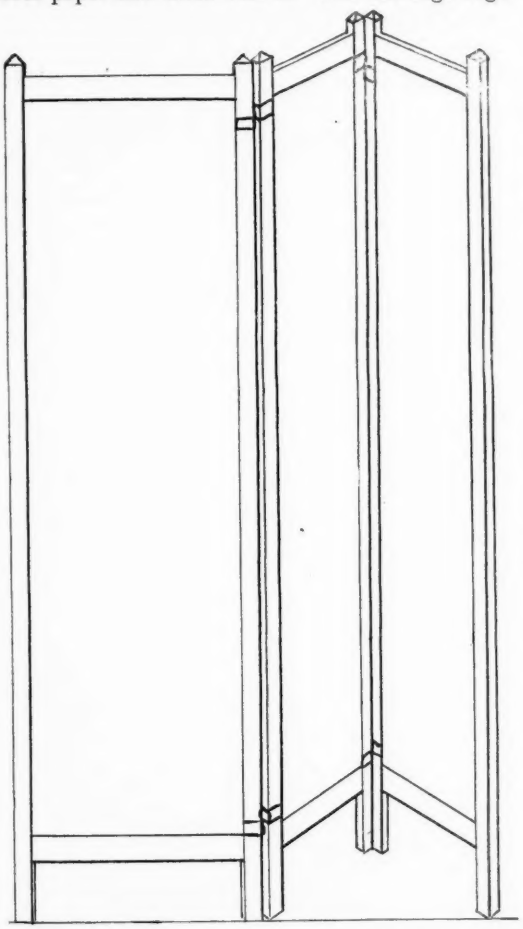
JOHN F. ADAMS.

A three fold screen, with a covering on one side of embossed wall paper, and a plain paper on the other, can easily be made at small expense, and will present a very attractive appearance. Additional decoration can be added by anyone desiring novel effects in the way of poster pictures which are cut out in outline, and pasted on to the plain sides, in which case the background should be a suitably colored cartridge paper. Other coverings such as muslin, leather, etc., can be used with this frame if preferred; with panels of thin wood pyrographic decoration may be used to good advantage.

The dimensions here given are for the ordinary width of wall paper, 18″ not including the selvedge, which should not be cut off. For a three fold screen there will be required for the frame, six pieces of clear grain, hard wood, 1 $\frac{1}{2}$″ x $\frac{7}{8}$″ x 6′, and six pieces 2″ x $\frac{7}{8}$″ x 20″, a four fold screen would require two more pieces of each size. Also six pieces $\frac{3}{4}$″ square and 62″ long, and nine pieces $\frac{3}{4}$″ square and 18″ long.

Tenons are cut on the ends of the 20″ pieces 1″ long, and $\frac{1}{4}$″ thick, to fit mortises cut in the 6′ pieces, those at the bottom being located to bring the lower edge 5″ from the floor, and those at the top to bring the upper edge, 1 $\frac{1}{2}$″ from the top. The top ends of the upright pieces are beveled to a point, the bevel being about 45°. Secure the joints with glue and dowels. With the pieces $\frac{3}{4}$″ square, make frames to just fit inside those just described, with scant allowance for the thickness of the material to be used for covering the panels. A centre bar is nailed in the centre of the frame; the corner joints are halved or mitred as may be most convenient. When covered, these frames should fit tightly in the others, being held in place by long, wood screws of small guage, put through from the inner or hinged edges, the outer edges each having three studs, made and placed by putting in wood screws and then cutting the heads off with a hack saw. This method allows the frame to be taken out at any time to repair or replace the coverings. Staining and finishing should now be done.

In covering with paper the inner frame is first covered with cotton cloth, which is glued to the wood, as well as tacked with small upholstering tacks sufficiently to keep it in place while the glue is drying, the cloth being carried over the edges of the frame. The paper is then glued to the cloth, using a rather thin glue and covering both paper and cloth with it. The selvedge edge



and a margin at top and bottom are carried over the edge of the frame and tacked to hold in place while the glue is drying. Another way is to glue the cloth and paper together before attaching to frame, and with embossed papers this will be the preferable way, only the minimum amount of glue being used, to avoid taking out the embossing. The covered frames are then attached to the frames as previously indicated.

The hinges are of leather, made so the folds may be swung either way. Eight pieces will be needed, each 3″ long and 1 ½″ wide, the kind used must be of a color to match or harmonize with the covering, and dressed on both sizes.

Ornamental, flat-headed tacks are used if obtainable. One end of a piece is tacked to one side of a fold, carried around the edge and to the other side of the other fold, to which it is being attached. Another piece is then tacked to the same folds, just below or above the under one, but on the opposite sides from the first pieces. This makes one hinge, and two are needed to each fold. By temporarily tacking them, they can easily be adjusted to just the right swing, and can then be permanently fastened.

FINISHING TURNED WORK.

F. W. Putnam.

A few general directions for the use of fillers and varnish upon turned work may be of interest to the readers of "Wood Turning." In general, the turned pieces should be given two coats of filler before they are removed from the lathe, following the directions given in the article on "Finishing Natural Woods."

Many instructors in wood turning advise that the various pieces be shellaced and given all but the final coat of varnish before they are put together, as they can be rubbed down with pumice stone and oil easier in the lathe. The final coat of varnish in any case is not applied until the model has been put together. Personally I have always felt that the better method was to set up and glue the parts of the model together before applying any varnish. In the first place, the model can then be varnished and laid away in a place where it will be free from dust, a thing that is very apt to interfere with the application of slow drying varnish to articles held in the lathe. If the model is put together before the varnish is applied, any excess glue can be gotten rid of much easier, and if any dirt gets on the model, in putting it together it can be wiped off with a piece of waste moistened in turpentine.

Let us assume then that the model has been put together, and that only two coats of filler

been applied. A thin coat of white shellac should next be used, this coat being lightly sandpapered when thoroughly hard with No. 00 sandpaper. This use of white shellac as a first or priming coat, over the coat of paste filler, is recognized as necessary by all manufacturers of fine furniture, work so treated requiring one coat less varnish to obtain the necessary surface to rub. This applies especially when a polished finish is wanted.

The paste filter only fills the pore; shellac is used to stop the absorption of those parts of the wood around the pore, to thereby bear out the subsequent coat of varnish. The first coat of varnish is then applied, care being taken not to put too much on for the first coat. When this is dry and hard, sandpaper lightly with No. 00 sandpaper and varnish again. This second coat must on no account be applied before the first one is dry. If this is done the result will be a sticky dirty looking job full of ridges.

This second coat of varnish is to be rubbed down lightly with pumice stone and oil. The first two coats should be thinned by the addition of one pint of turpentine to a gallon of varnish.

The third and final coat should be put on full strength and allowed to harden for a week if possible. This final coat must be absolutely hard before rubbing. Mix the pumice stone with water to about the thickness of cream; apply this to a woolen or felt cloth and rub it gently over the work; not too hard for that would cut through the varnish. After a little rubbing it will be noticed that the surface of the varnish shows a hard smooth body. When this is seen, wash the pumice stone all off, and apply rotten stone and oil or water, the oil is a little safer to use as you will not be so apt to cut through the varnish, but the water with the rotten stone will give the more brilliaut surface, showing the grain of the wood to perfection.

Use a bristle brush for the varnish. This should be soaked for an hour or more in cold water, to fasten the bristles before using. The varnish used should be the best grade of rubbing cabinet varnish; do not use spirit varnish as it is liable to crack and "rub up" in finishing.

I have spoken of the "weathered" effects obtained in gray, green weathered oak, and silver ash. The following formulas are given for those who desire to use such finishes: For the gray tones, from light to dark, use enough Payne's gray dirst, or color ground in oil, added to turpentine so as to give the desired shade when on a block of wood. It will be necessary to add one fluid ounce of Japan drier to each pint of turpentine in order to hold the color fast when the turpentine evaporates after penetrating the wood. Apply the stain with a bristle brush and allow it to stand for a few minutes, after which the surface is to be wiped clean with a pad of tow or an old towel that is soft and absorbent. To give the gray a slightly greenish effect add a small portion of terra verte.

The green shade is obtained in the same manner as the gray, except that olive green dust is added to the fluid. To get the brown shades add Vandyke brown, Cappa brown, burnt umber or brown ochre. If the latter is used add a very small amount of ivory or wine black. The silver gray can be made with Payne's gray, adding a small amount of white lead so as to give the mixture a slightly milky appearance. All of these stains should be tried on a separate block before applying to the finished article. Sometimes two thin coats are better than one heavy coat, as it is sometimes hard to wipe off the heavy coat evenly, especially on turned work.

Almost every consumer of mahogany appears to have some difficulty with the finish, this trouble resulting from the spongy nature of the wood and the very delicate colorings of some of the higher grades of veneer. This sponginess is so marked that some veneer shows a fuzz so fine that it almost requires a "lathe and shave" to get rid of it. A filler used over such wood is very liable to so gather in this fuzz as to show a clouded muddy effect, and at times detracts materially from the clearness of tone and so hides the finer markings of the wood and thus destroys much of the beauty of the finish.

A difficulty arising from the use of water stains is that the stain "frills up" the grain to such a degree that in sanding it down to a surface the fuzz is frequently cut down so low as to get below the stain and thus show innumerable little white point, which if gathered in quantity, show a gray effect. This trouble however can be cured almost entirely, if, before beginning to coat, the work is sponged with clear cold water,

allowed to dry and then carefully sanded with No. 0 sandpaper.

The clouding of the sponging parts can be cured provided the work is stained first and followed with a thin coating of white shellac and then filled. This shellac needs to be but a thin wash, not over two pounds of gum to a gallon of alcohol. When used of this consistency, it is not stout enough to clog the pores and yet will glaze all the soft spongy spots so that the filler when applied and properly cleaned off, will be found only in the pore.

Birch may be finished to represent mahogany very closely by coating with a weak solution of bichromate of potash, then staining with rose pink, Vandyke brown and burnt sierina, then with white shellac with a little Bismark brown dissolved in the shellac.

To finish mahogany, take one-third linseed oil two thirds turpentine, coat the wood and wipe off clean. When thoroughly dry, coat with bichromate of potash; then fill with a dark rich filler. Next use a light coat of white shellac and give three coats of varnish and rub with pumice stone and water. Next oil the wood and wipe off clean. If an extra good job is required, give the wood one heavy coat of polishing varnish after being rubbed in water, then rub again in water and polish. In finishing mahogany some put on the bichromate of potash without oiling, but they do not get as good a color.

All mahogany should be oiled first, unless you want a very light color, then it should have a thin coat of white shellac first". The above suggestions were offered by a member of the Ohio State Association of Master Decorators at their last convention in Cleveland, Ohio.

The *Lancet*, discussing the effect of the weather on the criminal classes, says, "Ranges of temperature appear to deflect the moral tendency to some extent, low temperatures serving to increase the daily average of prison offenses." On the whole, however, the criminal is said to be insensible to external impressions, while in similar circumstances the normal individual is affected sometimes considerably. Such a susceptibility to meteorological changes would imply strength of morals.

The bursting of emery wheels has been the subject of experiments by Professor Grubler of Germany, says the *American Machinist*. He drove the emery wheels by an electric motor at gradually increasing speeds until they burst, and one wheel sent a piece through a 16″ brick wall. No wheel ran quicker than 4,340 revs. per minute, at or before which speed all the wheels broke into four pieces as a rule. No wheel broke only in two pieces. The wheels were clamped by iron washers and cardboard discs, the latter not bursting. The wheels were cemented with various materials, such as rubber, magnesia, and ceramic. The first averaged a density of 2.78, the third of 2.3. The rim speed of breakage was 315′ per second for the first, 275′ for the second, and 243′ for the third. Professor Grubler considers that the strongest wheels contain the least emery, which means that the cement is stronger than the adhesion of the cement to the emery or than the emery itself. For the three classes his safe rim speeds are 102′, 89′ and 79′ per second, which he says are low figures, yet higher than the figures allowed by the German law. Eleven separate firms were represented by the fifty-seven tested wheels, and all fractures began in the inner bore, where theory says the stress is greatest. Obviously it should be a good thing to employ clamping washers as large as possible in order to afford support for the wheels.

Sawing woodwork joints to a fit is in many cases a quick, accurate, and simple means of obtaining a good joint between two pieces of end grain, says the *Bazaar*. The two pieces are brought closely together in the proper position, and are then clamped down or securely held while a saw-cut is made between the two. When the saw is withdrawn there is a space between them equal to its thickness, and this is uniform throughout the joint, unless the fit was originally so uneven that the thickness of the saw cut is not sufficient to remove the inequalities. In this case the parts must again be brought together and clamped, and a second cut made. This makes a perfect joint throughout when the parts are brought in close contact. This method is often quicker and easier than planing or cutting with a chisel.

AMATEUR WORK

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OCTOBER. 1903.

The February, 1902, issue of this magazine is, at present, out of print, but as the demand for copies still continues, a reprint will be made in the near future.

Are you working for the special grand prizes offered for the five largest list of subscriptions secured before Dec. 31. As the regular premiums are given for all subscriptions seeured, it is well worth making the trial.

Those who contemplate building the power dory, and would like to secure the frames, may join a club now being formed to secure the advantages of a wholesale order, by sending their names to the editor of this magazine, together with time when delivery is wanted.

In the next issue of this magazine, the first chapter of "Printing for Beginners" will be published. It is intended to present in this series, much information of the "Art Preservative" which has not, hitherto, been obtainable in book form. Numerous illustrations of the appliances for printing, and their uses, will make these chapters of interest to the general reader, as well as those who would follow it either in an amateur or professional way. There is probably no avenue of work open to the beginner, which can more quickly be made to yield a good income than the printing trade, provided its methods are carefully studied and diligently practiced. In these days of artistic typography, the demand for capable workman, who have progressed beyond the limits of mediocre work, is greater than the supply, and the young man who will acquire proficiency in the artistic, as well as the mechanical parts of the work will find his services in good demand. It is with the hope of rendering real aid to the beginner, and helping the amateur to a useful field of effort, that this subject will be presented.

A series of studies in "Machine Drawing" will begin in the next issue. These studies will give excellent practice to those interested in mechanical drawing, and also present much valuable information relating to the design of machines. Those of our readers who now are, or anticipate following a mechanical career will find these studies in accord with the latest drawing room practice, and giving a wide variety of work.

A discovery in British New Ginuea ought to be of great interest to anthropologists. The Administrator reports that a tribe has been found which is virtually incapable of walking. These people inhabit a marshy district which is too soft to admit of being traversed on foot, and too solid to allow of navigation in a canoe, or boat. Locomotion of any kind is thus impossible, and they have become a purely sedentary race, leading a stationary existence in the dwellings which they have built in the trees just above the level of the swamps. It would be natural to expect, under these circumstances, that they would gradually lose the use of the limbs and muscles employed in walking. This result has actually come about. They cannot perambulate on hard ground without causing their feet to bleed with the unusual exercise. Their extremities have shrunk, while the trunk has become bloated. The effect would be to produce a certain resemblance to the figure and gait of apes; but whether the similarity is based on real physical identities is a question.

AN EXPANSIONOMETER.

Robert Gibson Griswold.

Most substances expand upon the application of heat and especially is this so with metals. But this expansion is so small that, without some means of magnifying it, or multiplying it, our sense of vision would be unable to detect it. It is for this purpose that the present meter has been designed, and the levers are so arranged that the ratio of multiplication is 2,000 or in other words, a movement of 1-10,000 of an inch in the specimen will be indicated by a movement of 2-10 of an inch by the pointer on the quadrant. By this means the expansion of a metal may be readily determined and shown to the naked eye.

The specimen to be tested is conveniently made 10″ long, and is placed between an adjusting screw at one end and a knife edge at the other, the knife edge being attached to the vertical multiplying lever. Directly below the specimen in the base is cut a hole about seven inches long and four inches wide to accommodate a spirit lamp or Bunsen burner, with which the specimen is heated. The instrument as a whole is placed upon any convenient support which will raise it above the table so that the means of heating may be placed beneath it. During an experiment it is well to provide the source of heat with an asbestos chimney passing through this hole in the base so that little heat will be transmitted to the wood, thereby expanding it.

At the left hand end is a micrometer screw, provided for the purpose of setting the index at 0 on the quadrant scale after the test specimen has been put in position. When the specimen has been properly adjusted this screw is turned so that the index will stand exactly at 0. Heat is then applied, and as the temperature of the specimen increases, the index will move over the scale indicating the amount of expansion in the test piece.

This screw is also used to calibrate the quadrant. A point is selected as 0, after the screw has been set to its 0 and a specimen placed between the points. After marking the 0 position of the index, the screw is turned through one division which will cause it to advance 1-1,000 of an inch, and the position of the index is again marked. This operation is repeated until the entire quadrant is graduated. Subdivisions may be made by either spacing with dividers or estimating the proportional distance with the eye.

The base is best made of well seasoned maple or apple as they are very hard and retain their form well. It is 1″ thick, 8″ wide and 14″ long. An oblong hole 4″ x 7″ is cut in the base directly beneath the position occupied by the specimen. The upright support for the second multiplying lever, or index, with its pivots and yoke, is made of the same material. This piece should be mortised into the base and glued to make it rigid and secure. The arm supporting one end of the quadrant may be made of the same wood or of some softer, straight-grained variety. The quadrant is first cut from $\frac{1}{8}$″ cherry and then covered on one side with white Bristol board upon which the divisions are marked in India ink.

The micrometer screw is provided with a flat head two inches in diameter and $\frac{1}{16}$″ thick. It is mounted upon the screw proper by being driven up against a shoulder and secured with a small piece of brazing solder, which may be melted with a blow-pipe. Silver solder is perhaps the easiest to use and costs little. The screw is $\frac{1}{8}$″ in diameter and has 40 threads to the inch, which may be cut in a screw cutting lathe or with a $\frac{1}{8}$″.40 die, the former method being the better. The shoulder must be truly square or else the disc will wobble when turned. The point of this screw is drilled with a No. 20 drill and a piece of tool steel driven in about $\frac{1}{4}$″, the point is then ground to an angle of 60° while being revolved in the lathe chuck. Do not bring this point to a sharp termination, but round the end slightly with a small Arkansas slip as this will make a better wearing point.

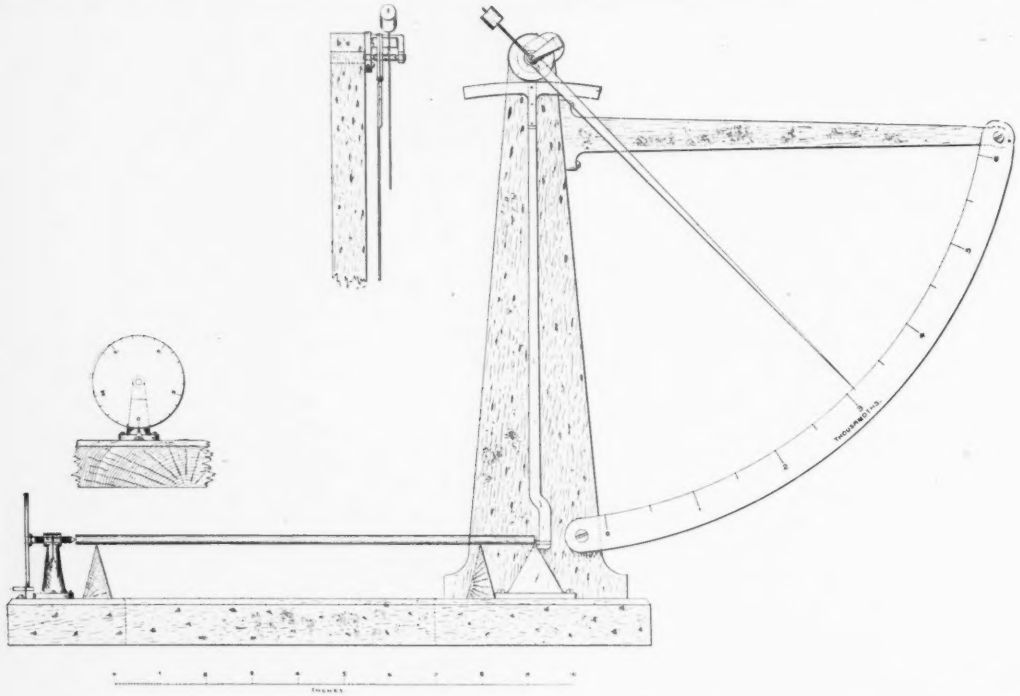
Divide the periphery of the head into 25 parts as shown. Each part will then represent $\frac{1}{25}$ of a

revolution and since one revolution of the screw will advance it in its nut $\frac{1}{40}$", this movement of $\frac{1}{25}$ revolution will advance the screw $\frac{1}{25} \times \frac{1}{40}$ equals 1-1,000".

The stand upon which this screw is mounted is made of cast brass. The bottom is a circular flange and provided with four round head brass screws. The upper end, or nut, is tapped with a $\frac{1}{8}$"-40 tap and split with a thin saw. The two halves are then slightly set together with a vise so that they will bind upon the screw, and effectually prevent its moving while a specimen is under test. Directly in front of this is shown a small gauge which is made by supporting a thin strip of brass filed to an edge upon some convenient support, in such a manner that it will lie very close to the edge of the divided head of the screw. This gauge may be quickly made by bending a piece of sheet brass into an L and filing the upright leg to a sharp edge.

The two supports upon which the specimen is laid are V shaped wedges of wood, terminating in a sharp, thin edge. The specimen is laid upon these to take the weight and the sharp edge will conduct a little heat. They are loose so that they may be placed in different positions and should be long enough to reach across the hole in the base.

The upright lever against which one end of the specimen abuts is filed from $\frac{1}{16}$" sheet steel. The upper end is provided with a segment made either of wood or brass, the outer edge being an arc of 10" radius, the centre being at the pivoted point of support. The lower end is supported by a casting which is firmly secured to the base. The lever fits into a groove filed in the apex and a small pin is passed through the two. This pin is easily made of a needle as it is hard and polished. It must fit the hole in the end lever very snugly so that there may be no play. The point against which the specimen bears is made of a small piece of tool steel which will fit over the lever and may be fastened there by a rivet or a small drop of solder. The bearing edge is ground to a sharp V and the piece hardened. The edge should be exactly $\frac{1}{10}$" from the pin, and since the lever is just 10" long, it will multiply the expansion 100 times, the ratio being 1-100.



The index lever is made from $\frac{1}{32}$″ hard brass and is 10″ long from centre of pivot to point. The point is turned from $\frac{1}{8}$″ steel and the ends provided with small cone cups into which the pivot screws. This cup should be nothing more than a small depression and is best made with a No. 80 drill, the sharp corner being taken off with a sharpened end of a file. On this pivot is also mounted a disc of brass, 1″ in diameter and about $\frac{1}{8}$″ thick, which is directly above the segment on the vertical lever, so that a small wire may wind from one onto the other. To the index lever is also attached a pin carrying a small weight or bob whlch can be adjusted so as to almost balance the weight of the lever. This partial balance is secured to relieve the system from any considerable strain, sufficient weight effect being allowed the lever to keep all joints tight and prevent any play. The lever and its pivot is mounted in a small yoke of cast brass, provided with two cone pointed pivot screws as shown. A hole is drilled in the wooden support to permit a screw driver being used on the inside one if adjustment is necessary. This yoke is fastened to the upright by two screws.

When assembled, connect the segment on the upright lever with the disc on the index shaft by a very thin steel wire, soldering the wire at each end to the disc and segment respectively. Any movement of the one will now be transmitted directly to the other. This means of transmitting the motion is adopted in lieu of the levers bearing against each other, as it gives a positive motion exactly like two gears and is much more simple. A better medium for this connection will be found in the phosphor-bronz suspension ribbon so much used on galvanometers, as this is about .001″ thick and about .02″ wide which of course renders it very flexible. Adjust the bob so that when a specimen is in place the weight of the index will cause the points to bear firmly against the ends of the specimen.

It is extremely difficult to heat a specimen of this length to an even temperature throughout its entire length, but if a tube of asbestos is placed around the specimen and the heat caused to travel through this tube from an opening in the underside about the middle to either end, a more even temperature may be secured. In shorter specimens it is less difficult and if in the present case a piece two inches long were taken, it could be supported by two wires strung from supports screwed into the base on either side of the hole, these wires taking one turn about the specimen to prevent its rolling to the side. The specimen may then be heated and when at the desired temperature, two pieces that have been previously prepared inserted between the bearing points (on lever and micrometer screw) and the ends of the specimen. The micrometer screw is quickly adjusted so that the index stands at the highest division of the scale, say 6. The flame is then removed and the three pieces allowed to cool together. When at the temperature of the surrounding atmosphere it will be found that the index has moved to a lower division on the scale and the amount that the specimen had expanded is thus determined. The expansion of the two pieces that are inserted will be so slight in the short time that the adjustment is being made that it may be neglected, and the assumption made that they return to their normal length. Of course these pieces must be the temperature of the room before inserting between the points, and for this reason should not be kept in the vicinity of the apparatus while the heating is taking place. A tube of asbestos may be placed over the specimen to insure its being heated equally throughout its length.

Following is given a short table of the coefficients of expansion for a number of materials in common use. The coefficient expresses how much a piece of the material named, 1″ long, will expand when heated so that its temperature is raised ° Fahrenheit.

COEFFICIENTS OF EXPANSION.

Name of Substance	Linear Expansion	Surface Expansion	Cubic Expansion
Cast Iron,	.00000617	.00001234	.00001850
Copper,	.00000955	.00001910	.00002864
Brass,	.00001037	.00002074	.00003112
Silver,	.00000690	.00001390	.00002070
Bar Iron,	.00000686	.00001372	.00002058
Steel (untempered)	.00000559	.00001198	.00001798
Steel (tempered)	.00000702	.00001004	.00002106
Zinc,	.00001634	.00003268	.00004903
Tin,	.00001410	.00002820	.00003229
Mercury,	.00003334	.00006668	.00010010
Alcohol,	.00019259	.00038518	.00057778
Gases,			.00203252

The following example illustrates how this table is used. A wrought iron bar 22′ long is heated from 70° F. to 300° F. How much will it lengthen? Ans. 22 x (300-70) x .00000686 = .41654″

A POWER DORY.

CARL H. CLARK.

III. PLANKING.

The planking of the boat is the most difficult part to the amateur, but if the directions are carefully followed, and sufficient time and care are given to the fitting, it is thought that no particular difficulty will be experienced. The planks are 5-8″ thick, of either cedar, pine or cypress; the first, however, is to be preferred. It should be as clear and straight grained as possible and in boards at least 12″ wide, for the upper strakes, and 18″ wide for the garboard or strake next the bottom. It is desirable to have the strakes in one length where possible, and the planks for the upper strakes should be gotten with this in view. This requires that they be about 21′ or 22′ long, if possible, as it is rather better to have them in one piece than to have joints. If this should not be possible, they should be in about 14′ lengths, so that the joints may come towards the ends of the boat, and not all in the middle, or any two joints in line.

It is not necessary that they should be of absolutely clear stock, in fact small, firm knots are rather an advantage, as they make the board less likely to split. Large knots, which might be likely to break or drop out, should be avoided.

The garboard, or lower strake covers the flat from the bottom, up to the first knuckle or corner, and is to be shaped to cover this space. It is to be noted that on account of the shape of the boat, this plank has a great amount of curvature, and on this account it is impossible to put it on in one length. The joint should come somewhere near the middle, but not on a mould.

The after part can be fitted first, the board being laid on around the moulds about in position, and adjusted to cover as long a length as possible, and is then held in position by shores, or short pieces of board with one end against the plank and the other on the floor. By cutting these shores rather long, and driving the foot in along the floor they will exert a wedging action, and force the board into place. In fact it will be found that a judicious use of shores, and braces will make it much easier to bend the several parts into place.

When the plank is adjusted it should be marked around the lower edge of the bottom, and the after side of the stern board, and a mark made at the corner of each mould, to outline the top edge. The plank is then taken down, and a line drawn through the marks with a batten. It may now be cut out to the lines, leaving something however, for fitting. It can be cut off about a foot beyond where it ceases to be wide enough to cover. It should now be sprung into place again, and any fitting required be done. The end where it is to be joined is cut so as to be parallel with the moulds; and beginning about 4″ back on the outside it is scarphed off diagonally, so that the forward part will lap on outside of it.

The piece for the opposite side may be cut from this one as a pattern, but must not be trimmed too close, as some must be left for fitting in place.

The scarph should not be carried to a feather edge, but should be left about 1-8″ thick, and the inner end of the scarph should be notched in that amount before beginning the bevel so that the end of the plank which laps over it may be 1-8″ thick to prevent splitting. The upper edge of the plank must be beveled off to the same line as the next flat above, so that the next plank may lie on the moulds and also make a smooth lap over the lower plank. While the plank is in place, with a chisel cut a short space at each mould nearly down to the proper bevel, as a guide, then, with the plank in a vise, plane off the whole edge to the proper bevel. The inner edge should be left about 1-8″ wide to prevent splitting off. After the plank is smoothly fitted it is ready to fasten in place. Nails about 2″ long are used for this, and are driven into each mould, and into the stern board. A row is also driven into the bottom, about 3″ apart. It must be remembered that the lower edge of the plank is yet to be beveled off to the surface of the underside of the bottom, and the nails must be driven nearly horizontally, so as not to be in the way later.

The forward part of the plank is fitted in about the same manner, except that the forward end is cut round to fit the stem. The scarph to fit that of the portion already in place should not be cut until the plank is fitted elsewhere. This scarph must be carefully made so that the edges will show smooth on the outside. After the forward part of the plank is nailed into place, the scarph is brought together, and the outside edge nailed with galvanized boat nails about 1″ long; they are driven from the outside about 1″ apart, a hole being started with a bit, to prevent splitting. The points are clinched over with a hammer, a heavy hammer, or piece of iron being held against the head; they are clinched across the grain, not with it. It will be found that the boat nails have a sort of flat point, and can be driven with the flat parallel with the grain, so that they will clinch easily and have less tendency to split. After

being clinched, each head should be hammered again lightly with the iron against the point, to set it firmly in place. The inner edge of the lap is fastened in the same way, but with shorter nails or tacks, as it is not desirable to clinch them on the outside.

If a plank cannot be gotten wide enough to cover the whole space, a short piece may be worked in to fill up the lower corner, and tapered off fairly ; its upper edge may be beveled, and the garboard beveled down over it and the joint nailed as described later.

The next plank ought to go on in one length easily and should be so done if possible. The procedure is the same with this plank as with the other, except that the lower edge should be fitted first. This lower edge comes just to the outer edge of the bevel on the plank below, and will have to be fitted largely by trial, as there is no room to mark it in the corner.

It is to be noted that all the plank bed upon the stem and stern board, and it will be found that in order to do this it will be necessary to bevel off the inner corner of this plank for a distance of two or three feet at each end to match the bevel on the lower plank, and bring it in flush at the ends so as to lie smoothly. When the lower edge is all fitted the ends and the upper edge can be marked and fitted. It is then beveled on its upper edge for the plank above, and may then be fastened in place, at one end first, it being held by a clamp on each mould and the stem. It is first nailed at one end and then to each mould and other end, working from one end toward the other. The lap is now to be nailed with about 1″ galvanized boat nails, driven about 3″ apart and clinched as before explained. A hole should be bored, and the nail driven from the outside, and the point clinched; the point should be bent down onto the solid wood, and not up, as this might cause the edge to split off and ruin the plank below. This clinching must be carefully done, and care taken to bring the joint up close, as the tightness of the boat depends upon it.

The position of the bent frames should be noted, two between each two moulds, and no nail driven there, as the nail at that point should go through the bent frame also. If a scarph has to be made in this plank the same directions apply as in the lower one except that the joint should be as far as possible from that in the plank below.

The third strake is put on in exactly the same manner as the second and ought to go on in one piece easily. If a joint is made, it should be as far as possible from those already made. The top strake will perhaps need to be pieced on account of its curvature. If this strake is made of oak it can be finished in varnish, which adds to the appearance.

The top edge must come exactly even with the upper edge of strip "I," already in place. It is not necessary that the top edge shall be fitted exactly now, as it can be planed down very conveniently after the moulds are cut down to the correct height. The plank where they overlap the stem and stern boards are now planed off evenly; at the stem they are cut square across to form a bed for the false stem or rubbing piece.

The plank should now have the corners beveled off and rounded, to avoid the sharp corner, which would be likely to get broken.

The intermediate or bent frames are now to be put in place. These are of oak, or other easily bent wood about 2″ x 3-4″. They must be straight grained, or they will not bend evenly; they run from the under side of strip *I*, and lap about 6″ on the bottom. They must be steamed in order to bend and for this purpose a steam box may be rigged up if desired, but the easiest way is to use a piece of pipe about 3″ diameter with a cap on one end. The pieces to be steamed are put in, as many as possible, it is half filled with water, the end is placed in a fire and as the water boils the wood is well steamed. If the stock is green and limber, it may be steamed by wrapping in cloths soaked in hot water. It should be steamed until it is limber and pliable and bends easily.

If a steam box is desired, it may be made from rough boards with one end closed and the other removable. Steam is led into it from some source, as from a wash boiler or kettle. One will hardly be necessary on the present work.

The frames are bent in while hot and can be fastened directly into place. There are two between each two moulds, as shown in Fig. 2, dividing the space about equally. They are bent well down into the corner at the bottom and fastened with two or three nails and with a nail at each lap where space has already been left for them. It will be noted that these bent frames naturally only land on the plank near the middle of each, but they should be drawn into the corners as much as possible, and the nails should be long enough to clinch inside the frame. When the frames are all secured, the braces may all be taken down and the braces taken off the tops of the moulds.

The moulds are now cut off 3-4″ below the top of strip *I*, to accommodate *J*. The tops are cut on a slight angle with the horozontal, with a rise of perhaps 1-4″ in the 3″ width, to give a slight slope to the deck. The top strake may now be planed off even with the upper edge of *I*, and fastened to it all along. The cleats which were fastened on stem and stern board to take the ends of *I* can now be removed also.

The strips *J* are 2″ wide, 3-4″ thick and about 16′ long. They are bent into place, using shores to the opposite side to hold them and are nailed into the tops of the moulds, also diagonally into *I*.

It may be well to now turn the boat up and plane off the edges of the garboard to the level of the underside of the bottom. The false stem *G*, is 1 1-4″ thick, and of a width equal to the combined thickness of stem and plank. It is of oak, and is steamed and bent into place and fastened with screws, and then beveled off to follow the line of the plank, and the point rounded, or the edge may be left about 3-4″ wide, and a piece of half round iron or brass screwed on.

It will be well, at this point, to fit the engine bed *Y*, as there is more room to work than there will be after the deck is on. These keelsons will have to be fitted according to the make of engine used; the fore and aft logs being preferred to transverse ones. The dimensions of the engine should be obtained and a line stretched from a point on the stern knee about 3″ above the bottom, to a point where the fly wheel of the engine will have sufficient clearance. The motor should be kept back as far as is convenient and yet give sufficient room to get behind it.

A position about as shown on Fig. 2, will probably give sufficient space. These keelsons should be about 2 1-2″ thick, and the proper distance apart to fit the flanges on the base of the engine. The ends should extend a couple of feet forward and aft to distribute the strain. The forward end is curved away to clear the fly wheel as shown. The after end will run up on the planking as shown, and should be carefully fitted and nailed; it is also fastened to the bottom with 3-8″ rivets.

Between the two keelsons there should be a cross brace, or piece of plank cut to fit between them on edge and fastened to them to keep them from tipping. This brace must be fitted to clear the round of the under side of the base, and may perhaps be left to be put in after the engine is obtained. If it is necessary to fit these foundations transversely they should be well fitted, and fastened to the bottom and also nailed through the plank.

The deck beams are now to be fitted in the positions shown in Fig. 2. They may be of spruce, or any desired stock, those at the ends of the cockpit are 2 1-2″ deep and 7-8″ thick, and are cut out of a board and should have a curvature of about 1 1-2″ so that the deck will not be flat. The ends are notched so as to fit up under strip *J*, and to bring the upper surface in line with that of *J*, so that the deck will lie evenly. A 1-4″ rivet is then put through the end of the beam and strip *J* and riveted over.

The other beams are 2″ deep, and 7-8″ wide, cut with the others as a pattern. The ends are cut off diagonally, a corresponding notch is cut in *I*, and a good sized nail driven in. The curved corner pieces *M*, are 3-4″ thick, shaped on the inside to give the desired curvature to the washboard; they are nailed to *I* and the heavy beams.

A piece is to be nailed to the stern board, as shown in Fig. 2 to take the ends of the deck plank; it should be curved to match the beams and be so placed as to be in a fair line with them.

The deck is of pine, tongued and grooved. It may be either covered with canvas, in which case 1-2″ stock is used, or it may be merely painted, when 5-8″ will be desirable. It is laid with the smooth side up and nailed to the beams to strips, *I* and *J*, and to the top strake; the edges and underside should be painted before putting together.

It is fitted nicely inside the stern board, and around the stem. The edges are then trimned off even with the top strake on the outside, and to a fair, even sweep on the inside. The inside edge should be cut so as to be just even with the inside of the strip *J*, so that the washrail will lie evenly, as in Fig. 3; at the ends it will follow the curves of the corner piecce *M*, already in place.

1=4 H. P. GAS ENGINE.

IV. COMPLETING AND ASSEMBLING ENGINE.

You are now ready to assemble the engine. At a distance of 3-8″ from the outer end of the cylinder and slightly to one side of the top, centre, drill and tap a standard 1-2″ 12 thread hole to screw the brass bearing for sparker rock shaft in. This must be screwed in very tight, with red lead, to prevent any leakage. Cut off the surplus, so as to leave the end about 1-8″ above the top of cylinder. You can now place the cylinder head on the cylinder, and mark off the five holes for the machine screws which fasten the head to the cylinder. Lay off these holes so that they do not come in the water inlets, nor against the brass bushing for sparker shaft. These are to be tapped for the 18 -16 screws. On the top of the cylinder, about 1″ from the crank shaft end, drill and tap for a 1-8″ pipe through the outer shell and through the inner wall of the cylinder. Cut a 1-8″ nipple about 1 1-2″ long with an extra long thread on one end. Screw this nipple into the cylinder tight so the end does not quite come through the inner wall. Use red lead to make it water tight. When the engine is finished screw the No. 1 oil cup to the top of this nipple.

The two water openings on top and bottom sides of cylinder are to be tapped with a 3-4″ pipe tap and a 1-4″ x 3-4″ bushing screwed into each one. A short 1-4″ nipple is to be screwed into bushing for a water connection. Drill the four feet with a 3-8″ drill for holding down bolts.

The small lug on the side of the cylinder in line with the valve chest is to be milled out to 5-8″ to receive the exhaust valve slide which must fit loosely in it. The small slanting shelf on the upper side of this lug is the support for the insulated contact spring which bears against the gear carrying exhaust cam. Lay

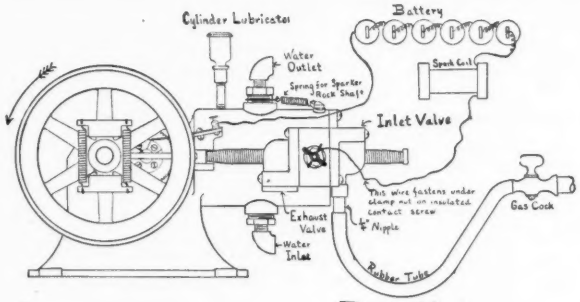
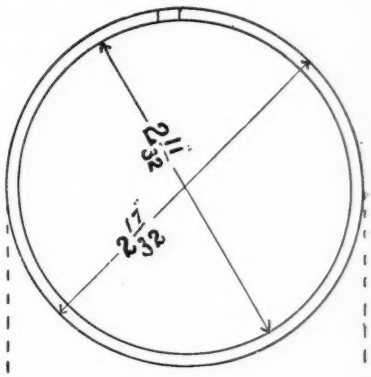
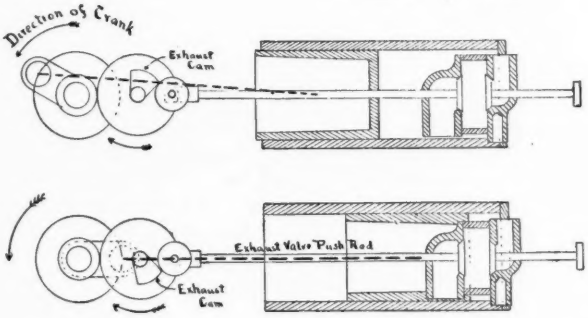
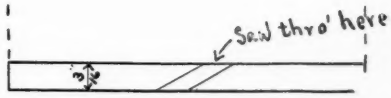


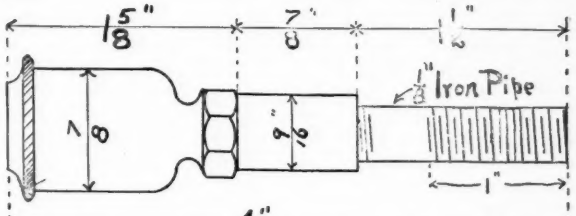
Plate No. 1.
Diagram of Water, Gas and Electric Connections for 1/4 H.P. Engine



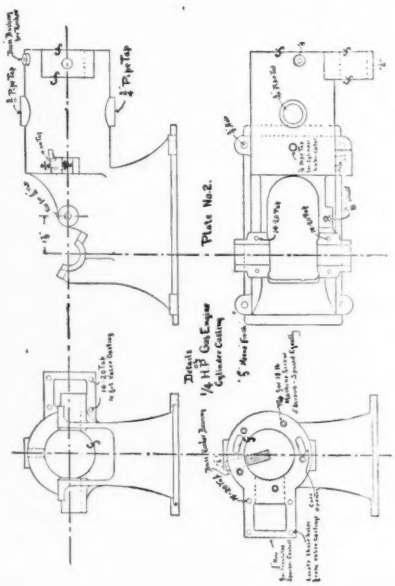


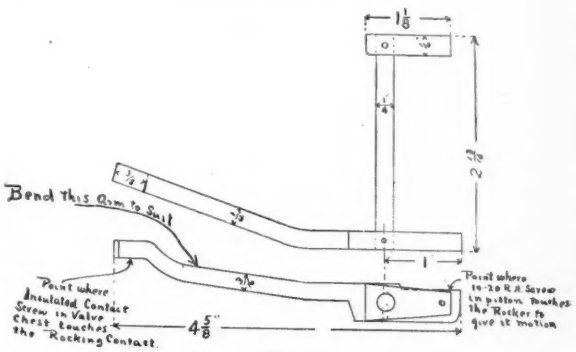


Packing Ring - Cast Iron
3 pieces - 1/8" all over



Cylinder Lubricator - No. 1 Oil Cup
One Piece




1 1/8
2 1/2
Bend this Arm to Suit
Point where Insulated Contact Screw in Valve Chest touches the Rocking Contact.
4 5/8"
Point where to 28 R.H. Screw in piston pushes the Rocker to give it motion

Sparker Rock Shaft
1 piece — Steel or Wrot Iron

the fibre piece on this shelf as shown in the genera assembled drawings. Drill and tap two 10-24 holes for machine screws to attach it by.

Lay the two bearing caps on the bearings and drill and tap the 14-20 holes for the machine screws which hold them in place.

Chuck the packing ring casting in the lathe and turn the outside off to 2 17-32 in. diameter; bore it out to 2 11-32 in. diameter and cut off rings each 3-16 in. wide. Saw these rings through at an angle and file out so that when compressed they will just slip inside the cylinder. Slip these rings over the piston into the grooves provided for them, two in the wide groove and one in the narrow groove. With the connecting rod in place, push the piston into the cylinder from the front end. Fit the connecting rod to the wrist pin of the crank shaft and draw up the two 1-4 in. bolts until the crank is held securely. Center this shaft in the bearings carefully. Close up each end of the bearings with putty and pour babbitt metal around the shaft. When cool, remove the shaft and file off the babbitt metal even with the surface of the iron casting. Now replace the shaft and bolt down the two bearing caps, being careful to insert a card board liner about 1-16 in. thick beneath them. Babbitt the upper half of the bearing the same as you did the lower.

Before proceeding further it will be well to drill and tap the holes for the 14-20 screws which hold the valve castings to the valve chest. Take up the inlet valve and mark off carefully and drill the four 1-4 in- holes. Lay this casting in position on the valve chest and mark off and center the holes to match the holes in the casting. Drill with a No. 9 drill clear through so as to come out on the crank shaft side. Tap these holes with a 14-20 machine screw tap to a depth of about 5-8 in. from each side. When this is done put the exhaust valve against the valve chest, and mark off and center the four holes on the valve casting. Drill these holes with a 1-4 in. drill. The next step is to attach the large gear which operates the exhaust valve. Slip the small gear on the shaft up against the bearing and pin it to the shaft by means of a piece of No. 36 steel or a wire nail if you can get no steel this size. Take the large gear, or as it is sometimes called, the secondary gear, and place it in position in mesh with the small gear. Mark off and center the hole for the supporting stud for this gear and drill the cylinder casting with a 3-8 in. drill for the stud to fit in. This will be in the small boss on the side of the casting. On the upper side of this boss drill and tap for a 5-16 in. set screw.

There is one more hole to drill; that on the side of the valve chest where the insulated sparker point is inserted. In the center of the side of the valve chest lay off and drill a 5-8 inch hole. Cut out some mica or asbestos washers and slip over the bushing and then place the iron washer over them, and lastly, draw up the brass nut to hold the bushing firmly in position.

It should now be completely insulated from their on of the cylinder. You can now fit the sparker rock shaft in the cylinder. This is clearly shown in the accompanying cut. The iron arm is to be bent so that it will bear against the insulated sparker screw in the valve chest and make contact with it. You must insert a 14-20 round head iron screw in the piston, so that when the piston reaches the end of the back stroke, the head of the screw will strike the short end of this arm and cause the long arm to move away from the contact screw. This will cause a spark in the valve chest when the circuit is thus broken, and it is this spark which ignites the explosive mixtnre. You will have to put the 1-4 in. shaft through the brass rock shaft bearing and then pin the bent iron from the inside. Fasten a small spring from the outside arm to the water outlet to hold the igniter arm against the insulated contact screw. This will be clearly seen in several of the illustrations.

This is the last operation to be done on the cylinder and the engine is ready to be assembled. Fasten the secondary gear in place and hold the bearing stud securely by means of the 5-16 in. set screw. Place the cam roller on the pin on the "L" shaped casting and insert this latter in the slot on the side of the cylinder.

Cut a piece of asbestos packing to fit between the exhaust valve and valve chest, being careful to cut out a hole for the valve itself to pass through. Soak this packing in asphaltum varnish or linseed oil, and then fasten the exhaust valve securely in place by means of two 1 in. 15-20 and two 2 in. 14-20 round-head iron machine screws. You can now mark off on the L shaped exhaust valve slide the place where the exhaust valve stem will screw into it. Do this very carefully and then drill and tap with a 1-4 in.—20 thread tap. Slip the exhaust valve spring in place and force it back.

You will now be able to screw the valve stem into the exhaust valve slide and secure it by means of the small hegagon lock nut. We will show you how to set the cam to operate the exhaust a little later. Bolt on the inlet valve the same way as you did the exhaust valve, using one thickness of asbestos packing.

Insert a piece of asbestos packing, previously soaked in asphaltum varnish, between the cylinder head and cylinder and then bolt on the cylinder head. Drill and tap the hub of each fly wheel for a 5-16 in. set screw and slip the fly wheels on the shaft. Set them with the balance weights opposite to the crank to balance it.

To set the exhaust cam place the crank shaft in position shown in Figure "B," with piston not quite out to end of stroke. Slip the secondary gear out of mesh wish the small gear, and turn it until the cam is just beginning to open the exhaust valve. Then put it back in place and turn the crank around in the direction of arrow until the piston is in the cylinder as far as it will go. The exhaust cam should now be just closing the exhaust valve. If it is not, you can file off the cam until it opens and closes the exhaust at the proper time.

On the next return stroke, the exhaust valve will be closed and the piston will compress the air behind it. The brass wiping contact will now be bearing on the

brass segment on the side of the gear. It must continue to bear on this segment until the piston reaches the end of the compression stroke when it should leave it. You may have to bend it or cut it off to do this. The governor lever or "latch" is the last piece to be put in place. It is to swivel on a pin through the end of the stud which supports the secondary gear and its function is to hold open the exhaust valve when the engine runs too fast. This prevents the engine drawing in a charge of explosive mixture and thus looses an impulse. As soon as the speed falls, the "latch" dis engages the exhaust valve and the engine draws in a charge on the next suction stroke.

No batteries or spark coils are furnished. You will need six dry batteries and a spark coil 5 in. or 6 in. long; these you can buy at any electrical supply store.

Plate No. 1 shows how the engine is to be set up. Take in the cooling water at the lower inlet and let the hot water flow from the upper outlet. Connect battery and spark coil as shown.

1-4 H. P. HORIZONTAL ENGINE.

B. R. Wicks.

IX. ERECTING THE ENGINE.

Having finished the liner to the dimensions given in the last chapter, the cylinder can now be placed in position on the cylinder bracket, and the four holes which will hold the cylinder in place spotted with a No. 10 twist drill; also the 3-16″ fillister head screws, which will hold the cross head guide to the cylinder bracket. The cylinder and cross head guide are to be placed on the liner; the flange of the cylinder and flange of the cross head guide must come tight up to the 1 7-8″ diameter by 8-32″ shoulder on the liner. Cut in two places in this shoulder, to get in two screws, which will keep the holes in the flange and the tapped holes in the cylinder flange in line, and also the two pieces in position on the liner. It will be noticed that there is a flat spot on the bottom of the 3-8 x 3-4″ oval flange on the cross head guide. This must be filed so that it will set flush with the square boss on the cylinder bracket. It should be 27-32″ from the centre of the cross heac guide.

Now take the cylinder bracket, which has been drilled with a No. 10 twist drill to the figures given on detail drawing, No. 368, and set the cylinder and guide central, lengthwise, as near as the casting will allow, and clamp in this position, Spot, drill and tap, using a No. 27 drill, to 7-16″ deep in the cylidder, and 7-32″ in the 3-8 x 1 3-4″ oval flange on the cross head guide. Tap with a 3-16-30 thread tap. The four screws can now be put in, and the cylinder fastened to the bracket. The cylinder bracket and main bearings are now to be placed in their position on the bed. In doing this operation, the cross head guide will have to be removed from the liner, as it will be in the way of the spotting and tapping drill.

It will be noticed that the end of the crank shaft extends 1-16″ from the face of the crank disc, so there will have to be a spot filed on the 9-16″ diameter end of the liner about 9-16″ long and 3-32″ deep, so that the liner will set against the face of the crank disc. Having done this, take the main bearings and put them on the crank shaft with disc attached and pinned in position. The clamp, using two clamps, one on each end, ther 9-16″ diameter of the liner to the face of the disc. Before clamping together put a piece of tissue paper between the liner and the face on each end.

To be certain that both ends are tight up against the face of the crank disc, for if one end was tight and the other loose it would throw the main bearings out of line with the cylinder and guide, bring up the shoulder of the crank shaft tightly against the face of the bearing. Now put the cylinder bracket main bearings, with disc and liner on the bed, and clamp in position. Have the centre of the crank shaft directly central with the line around the liner, 5 27-32″ from the centre of the cross head shoe stud.

Having accomplished this satisfactorily, and the clamps on the main bearings 2 5-16″ from centre to centre, spot, drill and top the 14 holes, put in the screws and fasten down. Take out all the screws. clamps, take all the parts of the bed, and clean all the dust and dirt away. Then replace the bracket and main bearings, put in all the screws, and test the accuracy with the tissue paper and liner. If perfectly square and in line, dowell the cylinder bracket to the bed and main bearings.

These pins must drive tight, and 1-8″ diameter is about the right size to use. Put two in the cross head guide opposite each other, and two in the bottom of each main bearing.

The only work remaining is to assemble the other parts, set the valve, paint, and make the gaskets for the front and back cylinder and valve chest covers, and one to be placed between the cylinder and valve chest,

They can be made from heavy drawing paper soaked in linseed oil for a day or two. The cylinder and valve chest can be coated with asbestos, and covered with a russia iron jacket held by small oval head brass machine screws of about 1-16″ diameter, which will greatly add to its appearance.

If this engine is built to the drawings and the directions given are followed from start to finish, every part will fit perfectly, as the reliability of the drawings and castings have been thoroughly tested.

JUNIOR DEPARTMENT

For the Instruction and Information of Younger Readers.

A MODEL "SHAMROCK III".

The accompanying lines show as nearly as can be obtained the form of the racing yacht *Shamrock III.*, and with the aid of the illustrations a good sailing or show model can be constructed. As the details of finish and method of construction for the show model will differ very much from those required for a sailing model, the parts of work common to both classes will be described first, and then that for each kind of model.

The model as measured by the scales shown is 3′, 9″ long on deck, 2′, 6″ long on the load water line, 8″ broad at the widest part, and 7 1-4″ on water line. The draught of the hull, including keel, is 6 3-4″; the height of the bow above the load water line is 2 1-2″ at the extreme end of the stern 2″, and at the lowest point of the sheer 1 1-2″. For a sailing model the displacement weight of the hull will be 10 lb. at the water line shown, and the hull weighing 2 lb. leaves 8 lbs. for lead on the keel. The sail area shown amounts to 1.590 sq. inches, which is about the right proportion to the actual boat, but would, of course, be far too much for a sailing model of 2′, 6″ in water line. This would only carry comfortably 1,000 sq in. which would make the vessel a five-rater, according to the rating rule.

$$\text{Rating} = \frac{\text{Length on L. W. L. x sail area.}}{6{,}000}$$

In making the model, first on a piece of yellow pine board, 1-8″ thick, draw full size the profile as shown by Figs. 1 and 5, and cut it out to use as a mould. Then make a similar mould of the half breadth of the deck, and outside moulds of each of the half sections shown by Fig. 3. The form should be obtained by measuring with the scale Fig. 4, and laying out the sizes so obtained full size. The best way to construct the model for showing purposes is to glue the wood together in layers, say from the bottom of the keel to the water line 2, in one piece; then from W. L. 2 to W. L. 1, and from W. L. 1 to the deck at the highest point of the sheer. The bottom piece and the top piece should be left with plenty of material for finishing. All the pieces should be glued together so that they come in the right position fore and aft, clamping them closely together, so as to prevent a wide seam showing. The process is to mark off the centre line on the model, and set off the location of the sections 0, 1, 2, 3, etc., which are equidistantly spaced 7 1-2″ apart. Then take the sheer mould of Fig. 1 and draw it in, taking care to see that the section lines on the mould and block for the model coincide. Now put the block down to this shape, and then put the half mould of the deck plan in place (after re-drawing the centre line which was cut away in getting the sheer), and draw it in, reversing for the other side of the boat. After cutting the block to this shape, apply the section moulds at their respective places and cut away until they fit exactly, then clean up the whole with a small hand plane. It is advisable to slightly hollow out a show model in order to provide for the contraction and expansion due to atmospheric changes. A good thickness to leave the sides would be 2″. After sandpapering with No. 2 and No. 0, the hull will be ready for painting and finishing. Ordinary paint is never used where a good job is desired, and it is best to get some flake white and mix it with red lead and white French polish until of a flesh color. Put on two coats of this over the whole model, and after they are hard sandpaper off, and put on another coat. Then sandpaper again only with old No. 0, as the new sheets are too rough. At least three more coats of paint should be given, proceeding as before described. To get a bronze bottom, turn the model upside down, and give the part up to the paint line shown on Fig. 1 a coat of good copal varnish. Spread it on evenly, then when it has almost, but not quite, dried, sprinkle on by means of an old pepper box some bronze powder of the tint desired, at the same time rubbing it smooth with the forefinger. Do not get any on the top sides if it can be avoided. The topsides can now be painted green by mixing some powdered green with French polish, giving two coats, which will be all that is necessary. Then when all is thoroughly dry, and any loose bronze powder has been removed with a fine duster, give the model a coat of copal varnish, and when that has been dried hard, which will not be for a week, wash it all dopn with water and the fine dust of powdered pumicestone, or rub with a piece of fine felt. This takes off the highly glazed appearance of the varnish. Finally the model should be again washed with clean water and dried with a piece of fine chamois leather.

For the deck, get a piece of white holly wood of the required size and 1-4″ thick, and shape it to the outline of the hull. Then plane it off until it tapers from 1-4″ thick at the middle of the length to 1-16″ at the extreme ends, and round the top until it is just 1-16″ thick at the outer edge of the deck; sandpaper it and give it a coat of isinglass. Then, with a drawing pen and Indian ink, mark in the deck planks as shown. Give them a coat of copal varnish, rubbing down with powdered pumicestone and repeating the process. Cut a little recess in the bottom of the boat for the mast step, which passes through the deck. Then fastened the mast step to the deck by means of

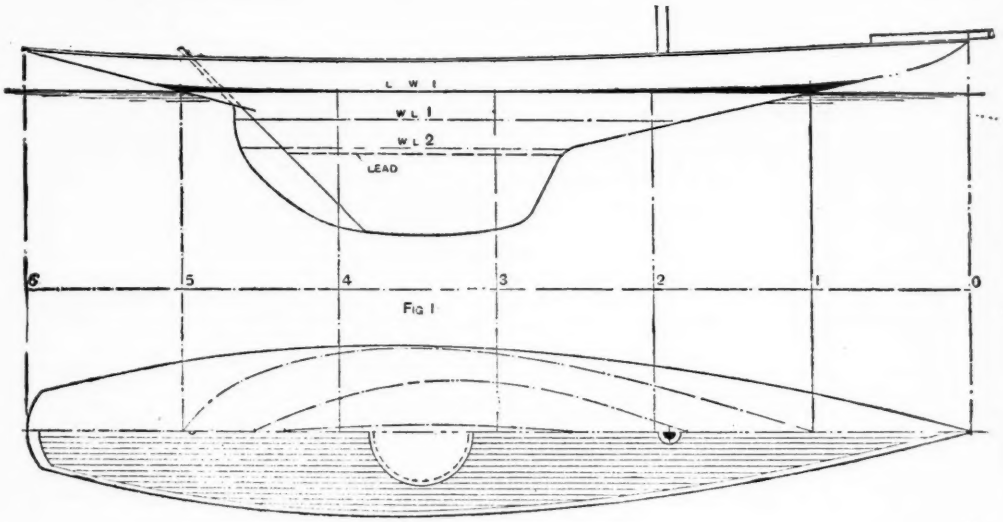


FIG. 1

FIG. 2

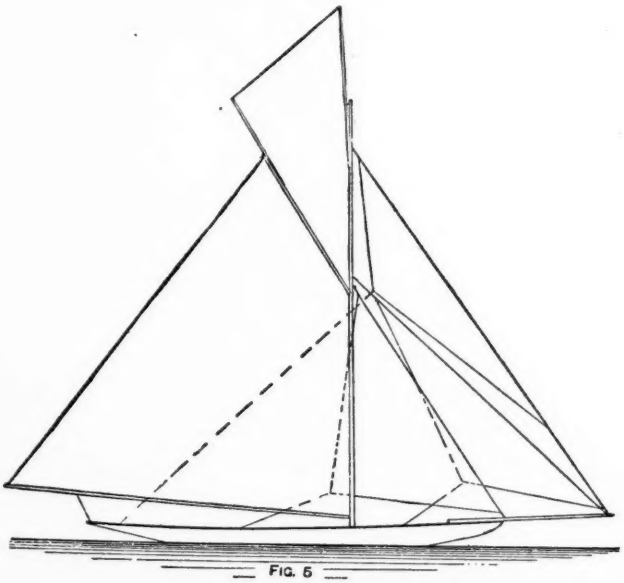


FIG. 5

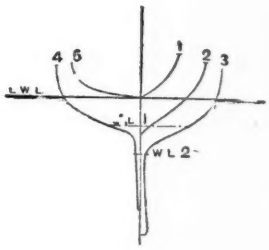


FIG. 3

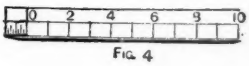


FIG. 4

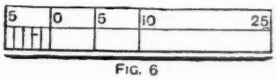


FIG. 6

very small gilt pins. The mast is 5-8″ thick, the boom 9-16″ thick, the gaff 7-16″ thick, and the bowsprit 7-16″ thick. They should be varnished in the same way as the deck. The sails are best made of lawn, and the dimensions may be obtained by scaling Fig. 5. For the rigging, the best way is to obtain a photograph of the actual boat and arrange it accordingly. The best material to use for rigging is silk cord.

A solid block of wood should be used for a model to be used for sailing purposes; the method of cutting it out will be the same as already described, except that the sides will be 3-16″ thick, with a lead keel, as shown by the dotted lines in Fig. 1, secured to the bottom of the wood by means of three long thin screws. In order to carry the sail plan shown, all the dimensions of the boat should be enlarged by dividing the length of the load water line into thirty six instead of thirty parts, and calling each of them one inch. This would make the boat a ten-rater.

Work, London.

A MODEL THEATRE.

A model theatre will be found a source of much entertainment during stormy or winter weather, when indoor amusements are desired. The one here described is inexpensive to make, and has enough of the features of a real theatre to give quite realistic scenes if care is used in making up the scenery and properties.

The greatest difficulty is the scenery, but by examining the illustrated weekly papers like Colliers, Harpers, etc., in time a sufficient number of double page pictures can be obtained, with which to make some excellent scenery, with the aid of a box of colored crayons or water colors. Perhaps some friend may have old papers to be had for the asking. This is mentioned first, as the size of the theatre depends on the scenery used, and the sizes given are for the scenery made as indicated, the double page pictures for the rear curtain measuring about 12″ high and 18″ long.

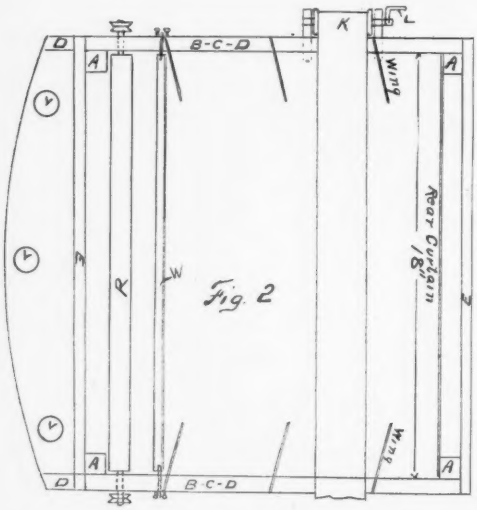


Fig. 2

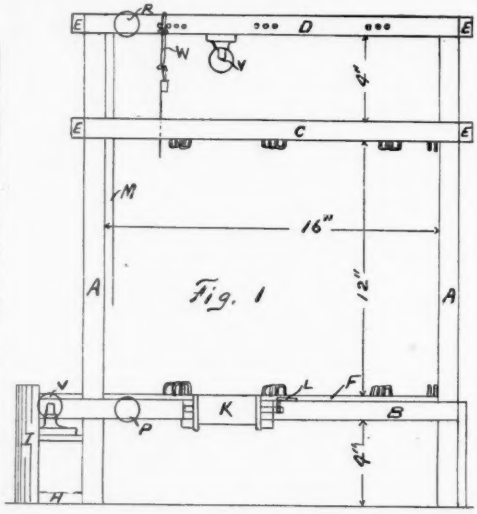


Fig. 1

The frame is made so that the stage floor is slightly elevated, for purposes which will be explained later. The four corner posts, *A*, are about 1″ square and 23″ long. The two supports, *B*, for the stage floor are 7-8″ x 1″ x 20″, and nailed with wire nails to the outside of the corner posts, so that the under edges are raised 4″ as shown in the side elevation, Fig. 1. These pieces project 2″ beyond the front corner posts. The floor, *F*, is made of smooth thin wood, and nailed to the supports *B*, after the rest of the frame is complete.

The pieces *C* and *D*, two each, are 7 8″ x 5-8″ x 18″, and also nailed to the outside of the corner posts, the pieces *C*, being 12″ above the stage floor, and *D*, 4″ above *C*. The five cross pieces *E*, the ends of which are shown in Fig. 1, are 7-8″ x 5-8″ x 20″, and also nailed to the corner posts. To the under side of the front lower piece, is nailed a strip of 1-4″ wood, *H*, which is 2″ wide at the ends and 4″ at the centre, the front edge being rounded in an even curve. A strip of thin flexible wood, *I*, 4″ wide and 24″ long, is nailed to the front edge of the piece, *H*, and also to the ends of *B*, forming the front of the stage floor. A piece of a wooden berry or butter box will be found suitable for the bent piece *I*. It may be strengthened at several places, by vertical strips 1-2″ square nailed to the inside to prevent splitting.

At points on the stage floor, and also on the under side of the pieces *C*, 3″, 8″ and 13″ from the front corner posts, are driven several double pointed tacks about 1-8″ apart, and with the inner ends nearer to the back of the stage than the outer, thus forming channels for the wings to slide in. The wings should be at an angle of about 75° from the side of the stage. At the back, drive other double pointed tacks to hold the back "curtain" so called, in this case made of cardboard.

Obtain four large spools at least 2″ long inside the flanges, on round wooden shafts 1 1-2″ longer than the spools, 1-2″ of the extra shaft being on one end, and 1″ on the other. These are mounted on each side of the openings between the centre wings, by nailing projecting strips to the under side of the supports, *B*, these projections having holes bored in them for an easy fit to the shafts in the spools, and long enough so the spools will be about 3″ outside the stage. Cranks for turning are made of wire bent to the L shape shown in Fig. 1, one crank being on one side, and one on the other. Strips of ribbon about 2″ wide and the same color as the stage floor, generally a slate or green, are then carried like a belt over the spools, one part above and the other below the floor, the ends being sewed with a lap seam. This ribbon belt should fit fairly tight, and the spools be so placed that the upper

section will lie flat and smooth on the floor and be as inconspicuous as possible. By turning the cranks, these ribbon belts will travel in either direction across the stage, and paper or other light figures placed thereon may be moved across the stage at any suitable speed or in either direction. A minute tack, put point up through one edge of the ribbon will carry, a wooden figure onto the stage, and turn it around if the larger portion of the base rests on the stage, the tack acting as a pivot when the ribbon is turned in the other direction.

The drop curtain, *M*, should be of thin cloth or silk. It is hung on a roller, *R*, made of a piece of 1″ round wood, a trifle less than 18″ long, on the ends of which are 1-4″ round wooden shafts, put through holes bored in the pieces *D*, allowing room enough for the thickness of the curtain when rolled up. The shafts should also be long enough to allow small pulleys to be fitted to the outer ends. These pulleys can be made from twist spools by filing grooves with a small round file. Similar pulleys *P*, are also attached to the supports, *B*, mounting them on round head screws. Around the pulleys carry an endless connecting belt made of heavy cord, the joint being spliced. A crank is made by driving a small nail into the spools on the roller, or the curtain can be raised or lowered by pulling on the belts. The bottom of the curtain requires a weight to keep it smooth when lowered. A piece of a brass curtain rod about 1-4″ diameter will answer.

The lighting is done with minature electric lamps, a bichromate or other form of close circuit battery being required. Bateries used for bell work will not answer if current is to be required more than a few minutes at one time. Three volt lamps are located, three at the front of stage and one on each of the top pieces, *D*. These are connected in parallel, the battery being also connected to give the right voltage. A reflector made of a strip of tin cut from a preserve can is placed between the piece *I* and the lamps. Switches for cutting out each lamp are placed on a strip of wood *S*, 4″ wide, nailed to the lower ends of the back corner posts. The battery is mounted separately and connected by wires when current is wanted. Strips of red or green glass placed before the lower lamps, will enable fine color effects to be added.

The scenery if obtained as previously mentioned, is mounted on heavy cardboard, the rear curtain having a screen on each side. The flies should be 12″ high and 3″ wide, the stage edges being cut to shape where possible. Smaller pictures, if they have the necessary height, can be used for the flies. Small strips of cloth or cut out pictures are hung just in front of the tops of the files to cover in the upper part of the stage. These are mounted on strips of wood, the ends being supported by strings with knots tied therein, and held between wire nails driven into *D* as shown at *W*.

The coloring of the scenery must be left to the artistic skill of the maker or his friends, but much depends on the success with which this is done. As most illustrations taken from papers, show a more or less number of people, some of them will probably have to be blocked out with crayon work. If the figures are very heavily printed, the easier way is to cover them with white paper and fill in with crayon work to harmonize with the rest of the picture.

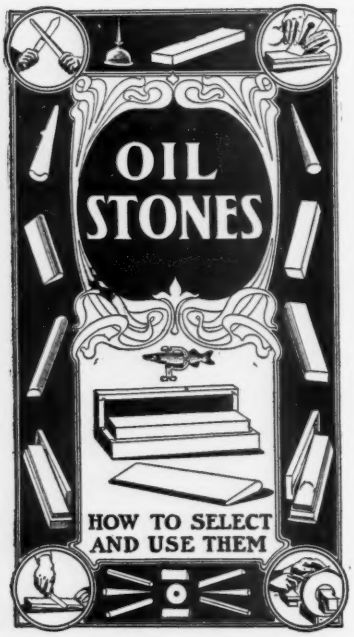
Interiors like castles, cathedrals, jails, etc., may have to be entirely drawn and colored, but this will not be found such a very difficult matter, if illustrations of suitable buildings are examined. Remembering the many hours of pleasure the writer has obtained from such a theatre (less the electric lighting,) as the one here described, the hope is expressed that other readers of AMATEUR WORK will find this description of interest.

DEVELOPMENT OF THE WORLD'S STEEL INDUSTRY.

The *Deutsche Industrie Zeitung* says that of all the countries producing steel in 1902 the United States led, with an output of 15,000,000 tons. These figures grow in importance when it is remembered that the world's production in 1894 was only 12,851,000 tons. Cermany's production in 1902 was 7,780,000 tons, one-half that of the United States; while England's was only 5,000,000 tons, or one-third the production of the United States. The world's total steel output for 1902 was estimated at 35,000.000 tons. This would indicate a growth of 700 per cent in twenty-two years, or an increase from a little more than 4,000,000 in 1880 to 35,000,000 tons in 1902. The great increase is due to the introduction and improvement of the processes, notably the flame furnace. Pennsylvania leads all parts of the world in the use of this furnace, followed by Illinois, New England, Ohio, etc.

The steel produced by the Bessemer process during the last fifteen years was used mostly for rails. In England more than half of the steel produced by the Bessemer process went into rails. In Germany and the United States the proportion is not so large. While the United States produced 9,306,471 tons of steel ingots in 1902, it turned out only 2,876,293 tons of steel rails, or about 30 per cent of the steel ignot production. In Germany the amount of Bessemer steel put into rails is proportionately smaller. Because of the resisting power of the steel, the wear and tear on the rails is far less; but the manifold uses to which the steel can be put has taken away somewhat from the importance of steel rail manufacture. The last twenty years has resulted in an age of steel. The universal opinion seems to be that the production of steel is to go on increasing. If, during the next twenty years. the same rate of increase is maintained as marked the past, 1923 will see an advance of from 20,000,000 to 25,000,000 tons in the world's total production. In this enormous increase the United States, according to experts, is to play the important part. At the very least, this opinion seems reasonable. The United States now uses in a year 30,000,000 tons of ore.

TRADE NOTES



We give above a reproduction of the title page of an attractive booklet put out by the Pike Manufacturing Co., widely known as the foremost manufacturers of sharpening stones in this country, if not in the world. The booklet contains information of value to every mechanic and user of edged tools, and is offered free to anyone who requests a copy by referring to the advertisement of that firm which appears in this issue of Amateur Work.

After a brief introduction, this booklet calls attention to the selection of oilstones for different classes of work; also gives a brief description of the leading oilstones on the market. A chapter on "How to Use Oilstones" is of unusual interest to every mechanic, another gives suggestions for their care, which, if followed, will render an oilstone efficient long past the ordinary term of service.

The machines for both wood and metal working, manufactured by the Senaca Falls Mfg. Co., Seneca Falls, N. Y., are so long and favorably known to both amateurs and professionals as to require no extended mention of their merits. Those who are not familiar with them, however, should become so, as they are machines well calculated, both from design, material and workmanship, to give the greatest satisfaction to purchasers.

Pyrographic work, when successfully done, requires that the opparatus be well constructed and of the best material. Many workers in this line hold the idea that the best platinum points are imported, but after using those made by the Smith & Hemenway Co., 296 Broodway, New York City, they will conclude that the latter are equal to the best imported, and by many considered superior. If users were familiar with the various trade marks, they might discover, as one noted instructor reeently did, that points supposed to be imported, were made by this firm, but sold by the dealer as imported. This is stated simply as an illustration of the excellent quality of the pyrographic goods made by this firm.

Now is the time when many of the pupils of manual training schools are required to purchase steel rules. By referring to any instructor, the high quality of those manufactured by Brown & Sharpe Mfg. Co., Providence, R. I., can be learned, as they have an international reputation for everything that goes to make a perfect rule.

The steel measuring tapes manufactured by the Lufkin Rule Co., Saginaw; Mich., are sold by about every hardware dealer in this country, and by many in other countries. This is simply because they are so well made as to give entire satisfaction to the user. The machine divided rules made by the same firm are rapidly becoming equally popular as the tapes.

The tool cabinets sold by Hammacher, Schlemmer & Co., New York City, are so well made, and fitted with such an excellent assortment of good, serviceable tools, as to be in a class quite by themselves. Ordinarily, such cabinets are for selling purposes only, but those sold by this firm may be purchased with the knowledge that full value is given in both the number and quality of the tools. The prices are also satisfactory, au illustrated catalog is sent upon request, if this magazine is mentioned when applying for it.

The wood scraper manufactured by Britt & Page, 1 Belle Ave, Lynn, Mass., is a tool which cabinet makers and wood workers, whether amateur or professional will find well worth the small amount required to obtain it. Much better work and more of it, can be done with this scraper, than by the old hand method. It is particularly well adapted for manual training school work, and should be found in the equipment of every such school.

A Machine particularly well adapted for use in manual training schools, and by model makers, is the 7 in. Shaper, manufactured by L. E. Rhodes, Hartford, Conn. It has all the essential requirements of the larger and more expensive tools, with the convenience and economy of space and power of a small one. For purposes of instruction in manual training schools it is particularly well suited.

The convenience of a wood trimmer, and also the more perfect work which may be done with one, cannot be fully realized until one has been used for a time, but having once used one long enough to know its possibilities, no wood worker would attempt to get along without one. To pattern and cabinet makers they are certainly indispensible. Those made by the American Machinery Co., Grand Rapids, Mich., are in design, materials and finish all that could be desired. Those who are not familiar with this type of tools should send to them for descriptive circulars. Manual training schools in which pattern making is tanght, should certainly be equipped with an Oliver Trimmer.

The battery rheostat, recently placed on the market by Kendrick & Davis, Lebanon, N. H. is the thing for regulating the current for operating the model electric railway, enabling the speed of the trains to be varied at will. As with all the goods made by this firm, the materials, workmanship and finish are all that it is possible to make them. A descriptive catalog of the rheostat, and many other electrical novelties, motors, dynamos, volt and ammeters, etc., will be sent upon application to this firm.

The small dynamo made by H. R. Swope, 120 N. 7th St. Philadelphia, Pa., is particularly well designed for furnishing power for the model electric railway, now being described in this magazine. It can be run by a water motor, the current being conveyed by wires to the point for use. It will also light quite a number of miniature lamps, and can also be run as a motor, giving it quite a field of application for the amateur electrican. It is well made, finely finished, and sold at a very reasonable price.

The "Eagle" pipe wrench manufactured by the Frank Mossberg Co., Attleboro, Mass., is one of the handiest tools for small work which an amateur or professional worker can possess. A perfectly firm grip, yet instantly applied or released, with a long leverage are a few of the features peculiar to this wrench, and which makes it well adapted to a wide range of uses; other wrenches, made by the same firm, are equally desirable, those for bicycles and automobiles having large, knurled adjusting nuts, by which they can be quickly and firmly applied to the work.

BROWN & SHARPE MFG. CO.

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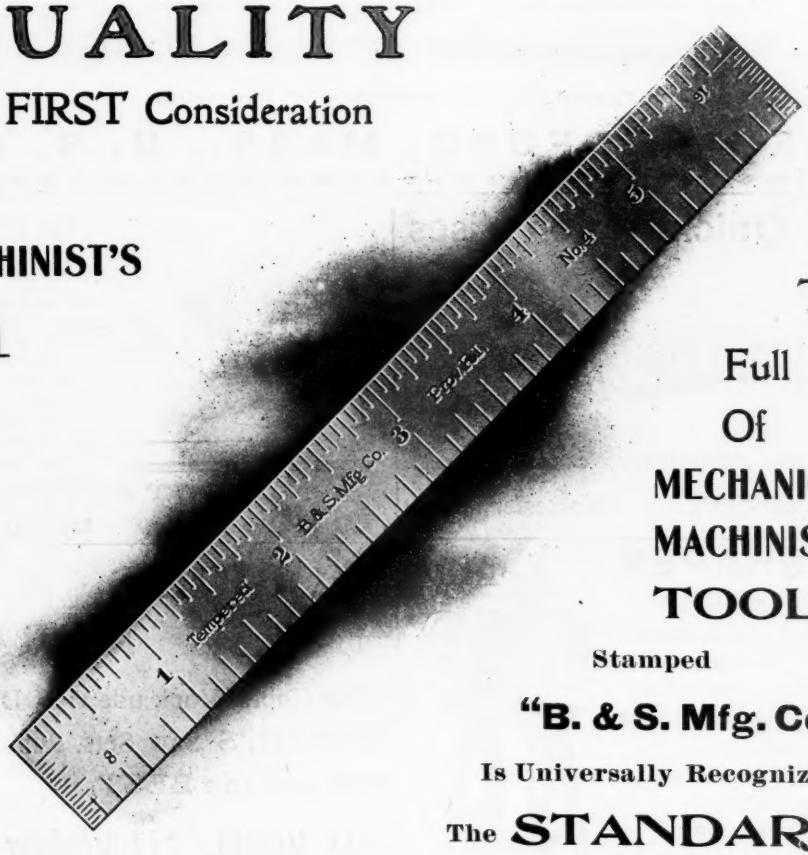

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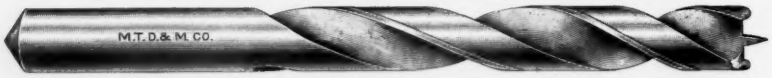

STRAIGHT SHANK MACHINE BIT FOR WOOD

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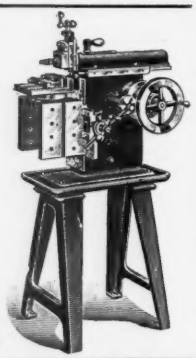

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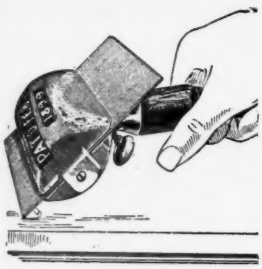

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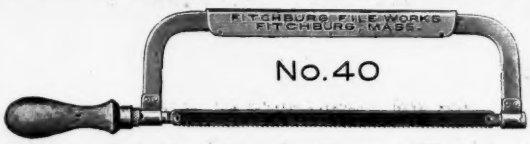

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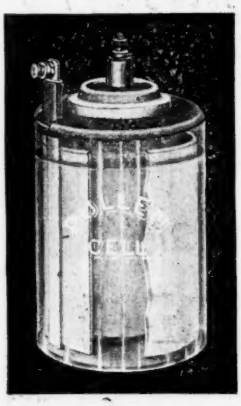

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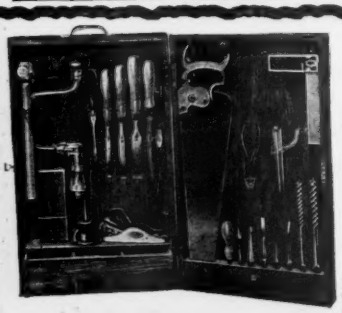

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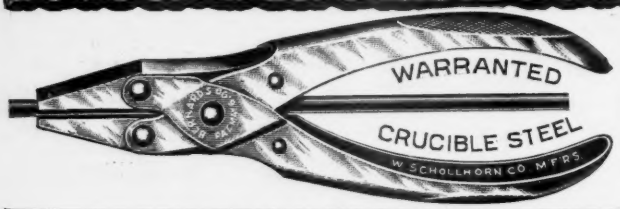

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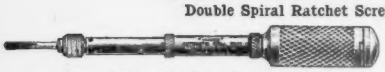

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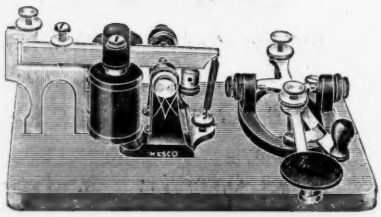

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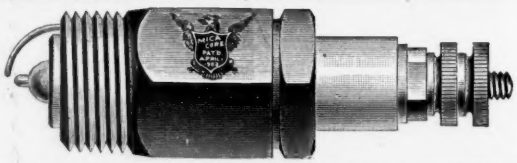

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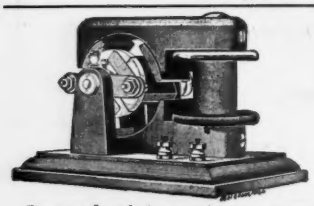

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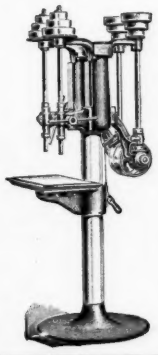

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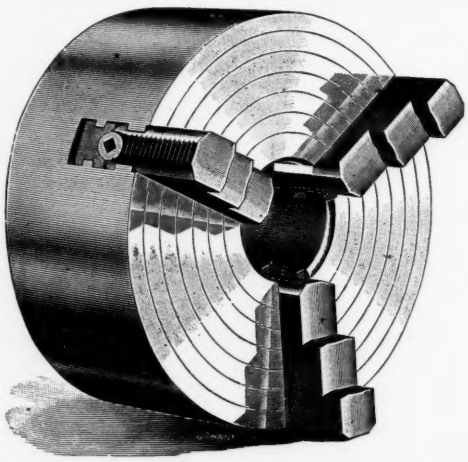

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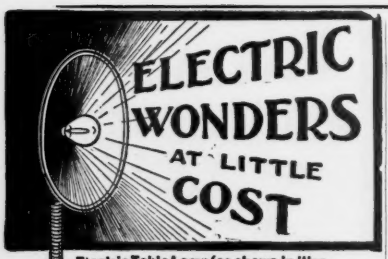

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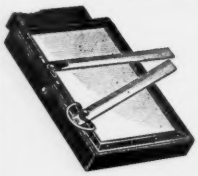

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